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Meters. AFTER a long series of investigations the British Board of Trade has not yet found an electricity meter which it can indorse. We wonder whether the same Board of Trade ever examined gas meters in the same way and found one which it could indorse. What a sale there would be for a gas meter that did not lie, provided, of course, the consumer and not the gas company had to select the meters.

Electrical Inspectors. ELECTRICAL inspectors have been appointed in some cities for the purpose of inspecting the installation of plants and wiring in buildings in order to guard against fires from defective work, and doubtless pressure has been brought to bear in most cities toward the establishment of the same system. In the early days of electric lighting such a precaution was perhaps necessary in the absence of trained insurance inspectors, but with the admirable system of insurance inspection now in force, it is difficult to see how greater security is assured by city inspectors. The recent underwriters' rules are more stringent and more strictly enforced than would seem possible under a municipal service, and even with the limited number of insurance electrical inspectors at present the great moneyed interest at stake assures a watchfulness that leaves little or nothing to be accomplished by city inspectors. With exterior wires it is, of course, different, and the energies of inside inspectors might be devoted to this direction with much more benefit to the community, particularly if they were given power to direct exactly where and how overhead wires should be put up instead of the lineman being allowed to follow his own fancy regardless of the disfigurement of the streets and the danger to life, either directly or through crosses.

Edison Patent Suits. THE Oconto lamp case, which came up on appeal at the United States Circuit Court of Appeals at Milwaukee on Nov. 11–13, is now in the hands of the court for decision. Both sides are unusually confident of success, and the outcome seems to be as much a matter of speculation as at any stage in the litigation. The recent opinion in the case of the Edison Illuminating Company, of New York, interprets a section of the celebrated clause in the original decision sustaining the Edison lamp patent, which offers the protection of the courts under certain conditions to certain classes adversely affected by that decision. The opinion is to the effect that the defendants, being competitors of the plaintiff, the court can extend them no aid that will enable them, through the use of the Edison lamp, to extend their competition, or to protect the competitive interests built up by them since the Edison lamp patent was sustained. The previous decision of Judge Lacombe is, however, so modified as to compel Edison lamps to be sold for such plants as were installed by the defendants previous to the original Edison decision of July 14, 1891, thus far, by implication, sustaining the refusal of the Edison Illuminating Company to sell lamps under any terms if it so chooses, within the limits thus allowed by the court. The full court seems to coincide with Judge Lacombe in the belief that there are lamps which do not infringe the Edison patents, as they state that it is not certain that there are not non-infringing lamps which may not be used. As we go to press we learn that suit has been instituted against the New York Insulated Wire Company and the Westinghouse Electric and Manufacturing Company for infringement of the Edison feeder and main patent at the World's Fair, and also against the Mount Morris Electric Light Company, New York. This suit is analogous to that decided this spring in favor of the General Electric Company by Judge Green of the United States Circuit Court of New Jersey, but which has been appealed. At the time of this decision the Westinghouse attorneys were very emphatic in the expression of their opinion that a reversal would be obtained on appeal, and called attention to the extraordinary statements of the Judge in regard to scientific points and to his singular definitions of scientific terms.

High Speed Railroading. AS curves are a necessary evil in railroad lines, some promoters of high speed electric lines have decided to abandon the every-day track and substitute one rail for two, not because, as it may appear to some at first sight, that derailment diminishes with the number of rails (there are really three rails in a "single" railroad), but because the car can then straddle the track. This seems to be rational. Numerous difficulties of less importance are being overcome in various ways, but after inventors get through with all of these and succeed we desire to call attention to another point, which seems to have been overlooked entirely, and we venture to say that it is of some importance, too. Among other necessary evils are the passengers, without which the road might be perfectly "safe" against loss of life of the passengers, but it would not be a financial success. After providing means for keeping the train on the track when rounding the curves at high speed, the next thing would be to provide means for keeping the passengers on their seats. It would be disagreeable, to say the least, to feel oneself hurled out through the window in the line of a tangent to the curves. The plan used in our horse cars and elevated lines of providing no seats and compelling passengers to hang on the straps, would answer provided the straps and the passengers were strong enough. Strapping the passengers down, like the victim in the electrocutioner's chair, or using hammocks, would also do. Hanging the seats from the roof of the car might answer, as it would only endanger the life of the conductor or any one else walking through the car while these pendulum seats were oscillating. What applies to the passenger as a whole applies also to parts of him, and we fear a malady resembling seasickness might prevail while rounding the curves, but here the inventor comes to a full stop, as he cannot reconstruct the anatomy of the passengers, even though he may invent and obtain a patent for an improved form. As inventors seem to have overlooked the centrifugal force of the passengers, we call their attention to it as a matter which is also of some importance. The only suggestion made so far was that of a Frenchman, who arranged the seats lengthwise in order that "passengers will suffer less from the shock of a collision." Although this idea has some points to be commended, it will not prevent those passengers which are on the outside seats from being hurled out of the window when rounding curves, except if there are no windows. Discouraging as it may seem, there are practical limits even to electrical high speed lines, which it will be well for inventors to recognize at the start.

A. I. E. E. Local Meetings. THE committee of the American Institute of Electrical Engineers appointed to consider the subject of local meetings has recommended, as will be seen in another column, a plan which is substantially the same as that advocated by the secretary of the Institute in a paper read at the previous meeting. As far as the measure provides for local meetings at which to read and discuss Institute papers, it will almost undoubtedly be satisfactory, not only to those in whose interest it has been adopted, but to all who feel that both justice and policy demanded such a recognition of the rights of those members not resident in New York and vicinity. While Messrs. Kennelly, Pupin and other members of the committee have earned the gratitude of the Institute by their liberal action in the matter, what they accomplished cannot be considered as closing the issue. There are yet two points to be settled, one relating to the auxiliary membership of the local meetings, and—the most important of all—the future status of the New York meeting. The demand from members at Lynn, Chicago and San Francisco that the numerous persons in those places interested in electrical pursuits, but not eligible to membership in the Institute, be allowed to have some connection with the local meetings, is not unreasonable. In all three of these places, and also at Pittsburgh, there is a large class to whom attendance at the local meeting would be of great benefit, and it is but natural that the members of the Institute in these localities should sympathize with the desire which many of this class will doubtless feel to participate in this benefit in some membership capacity rather than as mere outsiders. The plan proposed in the paper by the secretary of the Institute, to attach these to the local meetings as auditors or adjunct members, seems to adequately meet the case, and besides would provide for the necessary funds to carry on the local meetings, which otherwise will be no inconsiderable demand upon the local membership. The interest in this question will, however, be probably subordinated to consideration of the claim that the New York meeting is the Institute itself and not a local meeting like those just provided for. That local meetings outside of New York will be content to be mere appendages to the New York membership is improbable, and recent events have very forcibly shown that aside from this, and notwithstanding considerations of local pride on the part of New York members, such a condition is not only undesirable, but likely in time to disrupt the Institute. We can see no reason that the New York body should have any other status than other local bodies, but on the contrary see many why the legislative powers heretofore exercised by it should be taken away. In a professional and national body like the Institute, there is no reason why matters relating to its organization and conduct should be constantly tinkered with, and much less reason why the tinkering should be done at the New York monthly meetings, whose attendance is relatively small, and which can be easily packed to carry through any factional measure. All matters affecting the Institute as a whole should only be considered at the annual meeting of the Institute, whose attendance is more largely national in character and much more representative of the element most competent to deal with subjects vitally affecting the interests of a great professional body. It is doubtful if it was ever intended that the full powers of the Institute should be exercised by the New York monthly meeting, as they have been; and now that there will be other local meetings it is time the Institute should be placed beyond the power of any small faction in New York to control it, as it can now. Every professional body has probably passed through a crisis similar to that now experienced by the American Institute of Electrical Engineers. It seems to be their destiny to fall at some time in their career into the control of a faction, to be used for commercial or personal ends, and it has also been noticeable that those who thus usurp the power are professionally the least entitled to consideration—perhaps being merely members by courtesy, and not through professional acquirements. In this instance the remedy largely lies in transferring all the legislative powers to the national body of the Institute, to be exercised by it alone at its annual meeting, thus putting all of the local meetings on terms of equality. The new system of nominations places it in the power of the members of the Institute to suppress any attempt at factional rule, and the general interest in the elections that will ensue from the institution of local meetings will doubtless cause this power to be asserted, as it is not probable that the disgraceful tactics employed at the last election will again, if resorted to, prove successful.

The American Institute of Electrical Engineers.

At the eighty-first meeting of the Institute, held at headquarters, New York City, on Wednesday, Nov. 15, the business of the evening was the discussion of the report of the Special Committee of the Council on Local Meetings of the Institute. The report, which was favorably received, and adopted with some slight amendments, was as follows:

REPORT OF COMMITTEE ON LOCAL MEETINGS.

To the Council: Your committee appointed at the meeting of the Institute of Oct. 18 to consider the subject of local meetings beg to report as follows:

1st. It is the opinion of the committee that provision should be made for local meetings of the members at points inconveniently distant from New York for the reading and discussion of papers accepted by the Institute.

2d. The committee is of opinion that the provision in Section VI. of the Rules of the Institute authorizing the secretary to "call a special meeting on a requisition signed by 15 or more menbers" was not intended to and does not cover local meetings of the character contemplated in this report.

3d. The committee presents the following plan for the holding of local meetings of members:

A. When not less than 20 members in any stated locality shall in writing notify the secretary of the Institute of their desire to hold local meetings, such request shall be presented to the council at its first meeting thereafter. The council shall then, upon the recommendation and nomination of the signers of the request for local meetings, appoint a local honorary secretary, who shall be a member or associate member of the Institute residing in the specified locality.

B. The duties of a local honorary secretary shall be in general to serve as a channel of communication between local members, and the general body of members through the secretary and council. But no member in any locality shall be debarred from direct communication with the Institute.

C. In any locality where a local honorary secretary shall have been appointed, local meetings may be held, the local members to elect their own chairman, such meetings to be known as meeting of the ——— members of the American Institute of Electrical Engineers, and such meetings shall be for the purpose of reading, by the authors or by proxy, and of discussing, papers accepted by the Institute, and such papers only. Such local meeting shall be held simultaneously with the Institute meetings, or subsequently; that is to say, no paper before the Institute shall be read or discussed at a local meeting in advance of its reading at the Institute meeting.

D. Wherever local meetings shall have been provided for, as in the foregoing section, the local honorary secretary shall be supplied, by the secretary of the Institute, with a suitable number of advance copies of papers to be read before the Institute, which copies he may distribute to the local members at their local meetings. The local honorary secretary shall transmit to the secretary of the Institute a report of the discussions at each local meeting, together with any written discussions or comments on papers that he may receive from members in his locality.

Any member or associate may introduce a stranger to any meeting, but the latter shall not take part in the proceedings without the consent of the meeting.

E. The local honorary secretary shall transmit to the secretary of the Institute all papers offered by local members, but any member may send papers directly to the secretary of the Institute.

F. The publication of the discussions at local meetings in the Transactions of the Institute shall be subject to the same regulations and restrictions as govern the publication of discussions at the regular meetings of the Institute. No publication of papers or discussions at local meetings in local or other journals or newspapers is to be permitted without the sanction of the council or the secretary of the Institute.

G. The expense of local meetings shall be borne by the local members, and not become a charge upon the funds of the Institute.

H. The title, name and address of each local honorary secretary shall be printed in the publications of the Institute.

In dealing with the subject before it, and in preparing its report, your committee has carefully considered the documents and correspondence placed in its hands; particularly the paper of the secretary on "Monthly Meetings," and the plan for the establishment of chapters of the Institute drawn up by Dr. Emery, both of which were read at the October meeting.

The scheme for local meetings suggested in this report has been designed with the purpose of affording to members distant from the headquarters of the Institute opportunity to participate in its work on substantially the same footing as members whose location permits them to attend the meetings held in New York. The Institute is a national body, having members in every section of the country, but with a large preponderance of membership relatively near headquarters. Its work and its publications have a national significance. Its subdivision into sections or chapters would detract from the unity and strength of its efforts to serve the best interests of electrical science and industry.

Your committee, therefore, is of opinion that it would not be for the welfare of the Institute to create any separate local organizations or any class or classes of members not now provided for in its rules.

It is believed that the plan for local honorary secretaryships and for local meetings herewith submitted would meet fully the desire of members in diverse parts of the country to participate in the work of the Institute, and that it would avoid the disadvantage and disintegrating tendency that might arise from the formal establishment of a number of separate and distinct subsocieties.

HERBERT LAWS WEBB, Chairman,
A. E. KENNELLY,
M. I. PUPIN,
WM. J. HAMMER,
GEO. M. PHELPS, Committee.

NEW YORK, Nov. 10, 1893.

This report, on account of its general excellence, evolved comparatively little discussion. It was the feeling of those present that the system outlined by the committee was a happy solution of the important question of local meetings and would be acceptable to all parties concerned. It was taken up in sections, and several of the more important points drew forth some little discussion, in which Messrs. Phelps, Martin, Hammer, Hamblet, Emery, Kennelly, Perry, Wolcott and Crocker participated. There was considerable difference of opinion as to whether the clause in Section VI. of the Rules of the Institute did not cover such local meetings, and in the same connection it was suggested that the minimum number which could hold meetings in any locality be made 15 instead of 20, so as to conform to Section VI., but both of the portions of the report bearing on these questions were finally adopted without amendment. It was also proposed that where a vice-president of the Institute resided in a locality where meetings were held, he should be the recognized chairman of the meetings, but it was wisely decided to leave the choice of a chairman to the local members. The question of the exact nature of the report which the local honorary secretary shall transmit to the secretary of the Institute, and the advisability of the Institute bearing a portion of the whole of the expense of such a report was discussed, but the recommendations of the committee were here again adopted with some slight modification.

The most important point raised during the evening was that of the status of the local branches in relation to the Institute as a whole, the discussion on this point being evoked by a remark of one of the members to the effect that the New York meeting of the Institute was merely a meeting of its New York section; in other words, that the Institute was a national body, and that the New York members should hold meetings on the same basis as other local divisions. The discussion on the point did not become general, but President Houston expressed his views upon the subject. He thought that the New York section should continue to be the recognized official body of the Institute, and retain its legislative powers. He believed that any division of the Institute into local bodies having equal powers and privileges would be fatal to the best interests of the society, and eventually lead to its disintegration.

Before adjournment Prof. Houston reported to the Institute that his efforts toward securing a committee to thoroughly investigate the question of standards of light and illumination had met with success, and that the following gentlemen had signified their willingness to undertake the work: Prof. E. L. Nichols, Cornell University; Prof. C. R. Cross, Massachusetts Institute of Technology; Dr. F. A. C. Perrine, Leland Stanford Jr. University; Prof. F. B. Crocker, Columbia College; Prof. R. A. Fessenden, Western University, and Thomas A. Edison, Orange, N. J.

At the regular monthly meeting of the council in the afternoon, the following associate members were transferred to membership upon recommendation of the Board of Examiners: B. J. Arnold, Chicago, Ill.; C. D. Parkhurst, Fort McHenry, Mo.; A. A. Dion, Ottawa, Ont.; C. F. Uebelacker, Cleveland, O., and R. McA. Lloyd, New York City.

The Edison Lamp Case.

The United States Circuit Court of Appeals for the Second Circuit, in its decision of Nov. 13, in the case of the Edison Electric Illuminating Company vs. The Mount Morris Electric Light Company and the United Electric Light and Power Company, dismisses the claims of the defendants, based on the defense of delay of the Edison company in prosecuting its rights, and also the defendants' plea that they are illuminating and not manufacturing companies, and therefore included in the category of those declared in the decision sustaining the Edison patent to have strong equities.

The opinion states that the strength of the defense lies in the alleged extent of the injury which they would suffer from the entire stoppage of the supply of incandescent lamps. That the great injury anticipated is certain to result is declared to be not absolutely certain, nor is it certain that non-infringing lamps do not exist, which would be partially successful as substitutes for the Edison lamp. The court goes very fully into the matter of investments made by both the plaintiff and defendants, and finally orders the preliminary injunction granted by Judge Lacombe to be so modified as to only enjoin each defendant against the use of infringing lamps in any buildings lighted subsequent to July 14, 1891, the date when the Edison patent was sustained, and gives liberty to the Edison company to renew the motion if, in its judgment, the defendants refuse, upon reasonable terms and for reasonable prices, to pay for patented lamps in buildings in which the use of such lamps is thus not enjoined—that is, those in which the lights were installed previous to July 14, 1891. It was further ordered that the defendants should file within 30 days a list of all the buildings lighted by them subsequent to July 14, 1891.

The Oconto Incandescent Lamp Case.

The case of the Electric Manufacturing Company, et al. vs. The Edison Electric Light Company and Edison General Electric Company, which came up on appeal before the United States Circuit Court of Appeals for the Seventh Judicial Circuit, at Milwaukee, Wis., on Nov. 11 and 13, is another important step in the series of lamp patent suits which followed the introduction of what is known as the Goebel defense into the now celebrated Beacon case at Boston. While public interest is not perhaps as keen as when this defense was first brought out, to those who have watched the progress of this litigation not only each new decision of the court is a matter of considerable moment, but the preparations for the hearings, the arguments presented, and the attitude of the court toward the disputants, is always closely followed.

The case was conducted on both sides by counsel who have been connected with the suit almost from the first and have so ably represented their respective interests in the past, Messrs. W. H. Kenyon, J. J. Herrick, A. D. Kenyon, A. P. Smith, of counsel, and W. H. Webster, solicitor, for the appellants; and C. E. Mitchell, F. P. Fish, R. N. Dyer, D. H. Driscoll, of counsel, and H. G. Underwood, solicitor, for appellees.

In view of the importance of the case, the court granted two days, or a total of ten hours, for its argument. Judges Woods and Jenkins (circuit judges) and Judge Bunn (district judge) were on the bench, Judge Woods presiding. The case was opened by Mr. J. J. Herrick, for the appellants, who spoke for about an hour and a half. He confined himself chiefly to the rule of law adopted by Judge Seaman, and on which Judge Seaman decided the case, and argued that both Judges Colt and Seaman were wrong, and that Judge Hallett was right in this matter. Mr. W. H. Kenyon then followed for an hour, speaking upon the same subject and upon the facts, carefully reviewing the Goebel story and bringing out clearly and strongly its important points. After the lunch adjournment, Mr. Kenyon was about to proceed with his argument, when he was interrupted by Judge Woods, who stated that under the circumstances of the case the court desired to hear counsel for the appellees on the rule of law.

Mr. C. E. Mitchell then addressed the court for the appellees on the rule of law. Mr. Mitchell made a vigorous attack on the evidence of the appellees, claiming that lamps Nos. 1, 2, 3 did not embody the invention of the patent in suit, that they were not operative, and that they were fraudulently made for the purposes of this defense, and that lamps Nos. 4 and 9 were made after the date of Edison's invention. Mr. Mitchell stated at the close of his argument that in any event, in any holding of the court as to the proper ruling of law to govern the case, the appellees would contend that the evidence was insufficient, and that the injunction should have issued as it did.

Judge Woods then stated that under such circumstances arguments on the facts would have to proceed, and Mr. W. H. Kenyon addressed the court for an hour and a half, when adjournment was taken.

On Monday, Nov. 13, Mr. R. N. Dyer opened for the appellees, and spoke at length in his usual clear and forcible manner. He dealt especially with the state of the art prior to Edison's invention, and gave prominence to the antecedent improbability arising from such a state of the art. He was followed by Mr. J. J. Herrick, who ably plead the cause of the appellants, and then the arguments were closed by Mr. W. H. Kenyon, who spoke for about 40 minutes previous to the final adjournment of the court. Mr. Kenyon critically reviewed the case, and then directed his attention to several of the main points of the appellant's argument, attacking in particular their claim that Goebel had neither pumps nor tools with which to construct his lamps previous to the date of Edison's inventions. Mr. Kenyon argued very earnestly and forcibly and with evident effect.

Throughout the case the court showed great interest and frequently interrupted the counsel to question them on some important point. It was evident that the judges were following the case with great care, and their de-

cision will therefore be awaited with more than usual interest.

During Monday's session, Judge Taylor, of the Fort Wayne Electric Company, submitted a brief to the court in behalf of the appellees.

The court adjourned to meet for consultation on Nov. 30. It is quite probable that an opinion may not be handed down before the first of the year.

An Important Suit.

A suit has just been brought in the United States Circuit Court for the Southern District of New York by the Edison Electric Light Company against the New York Insulated Wire Company, and the Westinghouse Electric and Manufacturing Company, for infringement of the Edison feeder and main fundamental patent.

Candle Power of Search Lights.

BY CHAS. P. STEINMETZ.

I am very sorry to see from Mr. Hering's remarks on my note on search lights that he has considered it as personal. Far from having this intention, my remarks essentially coincide with Mr. Hering's, and they are meant to be used to correct some misunderstandings on the matter under discussion which are made very frequently; and that quite curious views exist on this subject has in the meantime been proved again conclusively by a collection of mistakes in the editorial remarks of the London "Electrician."

Referring to the law of inverse squares, the only qualification required is, as stated in the closing sentence of my note, the same as that in photometric tests of any source of light, as an incandescent lamp, viz., that the distance from the light must be large enough to make the diameter of the light negligible against the distance.

In the photometry of incandescent lamps a distance of one metre is considered more than necessary to apply the law of inverse squares. This is 25 times the height of the flame of a standard lamp. Hence with a reflector of 5 feet diameter, a distance of 125 feet from the reflector is sufficient to permit the application of the law of inverse squares. Usually larger distances, as 1,000 to 5,000 feet, are preferred for convenience. In this distance the law of inverse squares holds true, and the atmospheric absorption in clear nights is still negligible. In the diagram shown in Mr. Hering's note this condition is not fulfilled, and therefore the inverse square law does not apply. The point P, shown there as apparent centre of light behind the reflector, does not exist, as the attached diagrams will show.

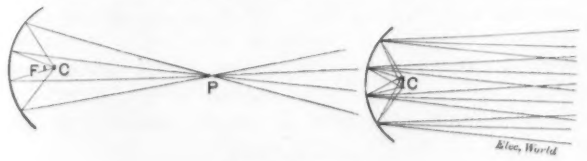
In Fig. 1 the source of light is a mathematical point

FIGS. 1 AND 2.

in coincidence with the focus F, and in this case the light leaves the reflector as a beam of parallel rays, and the rays appear to come from a point of infinite candle power at infinite distance, i. e., the term "candle power" becomes meaningless.

In Fig. 2 the source of light is point C, inside of the focus F, and the rays leave the reflector divergent, exactly like coming from point P behind the reflector.

In Fig. 3 the source of light is the point C, outside of



FIGS. 3 AND 4.

the focus F, and the reflected rays converge toward a point P in front of the reflector, so that at a distance the light seems to emanate from a point P in front of the reflector.

By f = focal distance, it is approximately:

$$f^2 = \overline{FC} \times \overline{FP}.$$

These figures 1 to 3 are of theoretical interest only, and cannot be realized in practice, since the source of light is not a point, but a finite area, the crater of the arc. In this case, shown in Fig. 4, each point of the reflector surface is the centre of a pencil of divergent rays, and the rays leave the reflector with the natural dispersion, which, however, is not a true divergence, like in Fig. 2, and there exists no point where the rays converge, or seem to emanate from, but every point of the reflector acts like a source of light or like a point of the crater.

The appearance of the beam of light in a greater distance will be similar to Fig. 5, i. e., the beam consists of a cone a, in which every point receives light from all the points of the reflector surface so that for the cone a the reflector acts like a crater of the area of the reflector. This cone a is surrounded by a penumbra b, which receives light only from a part of the reflector, and where the intensity gradually decreases from the full brilliancy of the interior cone to the outside darkness. Further there exists a cone c, receiving light only from a part of the reflector also, but in such a way that

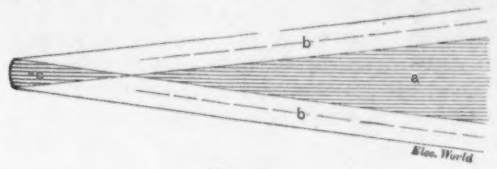


FIG. 5.

in c the surface intensity is approximately constant, similar and corresponding to the beam in Fig. 1. In a, however, the intensity varies proportionally to the square of the distance from the reflector.

As diameter of the beam of light it is customary to consider the diameter from centre of penumbra to centre of penumbra, as shown in dotted lines in Fig. 5.

Superposed upon this natural and unavoidable dispersion of the beam due to the finite extension of the crater can be a further dispersion by moving the lamp out of the focus, as in Figs. 2 and 3, and this is done where dispersed light is desired. With the lamp in the focus, however, as in Fig. 4, the reflector can, at all points within the cone a, Fig. 5, be replaced by a crater of the size of the reflector, and the inverse square law applied.

Obviously the distinction between central cone a and penumbra b is in practice by no means as sharply defined as shown in Fig. 5, in consequence of the unavoidable irregularity of all human apparatus; and furthermore in consequence of a small variation of the angle of dispersion for different points of the reflector surface, as shown in Fig. 4.

I hope that these remarks will be sufficient to clear up the misunderstanding on the question of search lighting, which now very widely exists.

I inclose a copy of a letter to the London "Electrician," correcting the mistakes contained in its recent editorial, which was reprinted in your last issue.

To the Editor of the London Electrician:

Referring to the editorial remarks on the candle power of search lights, I am very sorry that you should have so thoroughly misunderstood the meaning of my letter as to assume that I referred to the surface illumination produced by the beam of light. I precisely meant the candle power of the search light as measured in the same way as is done with any incandescent lamp; for instance, by photometric tests at a distance sufficiently large to make the diameter of the light negligible against the distance, so as to make the law of inverse squares applicable.

I think I can trace the source of this error in your editorial remark to a mistake as to the nature of the rays emitted by the light, an error which, by the way, is frequently made. You seem to assume that the rays of the search light are naturally parallel, and that what there is of divergence is due to irregularities, etc. This would, indeed, be true if the light giving source were a mathematical point in coincidence with the focus. Since, however, the crater of the arc is not a point but an area, there exists a true divergence in the rays of the search light, and the rays issue from the reflector not mainly in one direction only as a parallel beam as you state in your remark, but about uniformly in all directions within a small spherical angle, the angle of divergence of the beam. The result hereof is that the diameter of the beam—except in the immediate neighborhood of the reflector—is proportional to the distance from the reflector. Hence, the illuminating power is inversely proportional to the square of this distance, and the search light acts exactly similar to an ordinary arc lamp with a screen with a round small hole in front of the lamp, which permits only a beam of small angular diameter to pass, but by no means a beam of parallel rays.

It is certainly not possible in the short space of a letter to give a complete treatise on the search light, correcting, for instance, the further error you make in your editorial, that only the solid angle subtended by the reflector needs to be considered, and that the large size of the reflector is therefore only for the purpose of avoiding shadows, etc.

I may refer you to a short treatise on this question by Mr. F. Nerz, in your own paper, the "Electrician," where I hope you will find all the explanation necessary to understand the fact that the photometrically observed candle powers are really of such magnitudes.

Nov. 7, 1893. CHARLES P. STEINMETZ.

Comparative Cost of Steam and Water Power.

To the Editors of The Electrical World

In your issue of Nov. 11 I notice an article and an editorial on the comparative cost of steam and water power, the latter transmitted by electricity, from which a reader uninformed on the subject would conclude that it would be an unusual case where the transmission of power by electricity would be profitable.

I concur in the statement that electrical manufacturing companies are not the proper parties to decide upon the practicability of an undertaking of this kind, and that such enterprises are projected without sufficient consideration being given to the numerous conditions which may have important bearing on the commercial success of the plant. This is comparatively a new departure in the electrical field, and few are qualified to pronounce upon the feasibility of these propositions, or to investigate them thoroughly from all sides and in all their phases. The consulting engineer in preliminary work on a proposed plant of this nature should be, not only a thoroughly competent electrical engineer, but equally well informed on the application of the power transmitted to the particular purposes, and the nature of all work to be embraced. It is injurious to the industry to publish statements of unfortunate cases, ill-advised no doubt, and here base unfavorable comparisons with steam unless a clear exposition can be made of all conditions. I want to state here that I have designed and installed a number of transmission plants, all of which are most successful, and with them have been accomplished results that would not have been obtainable in any other way. One of these plants cost in the neighborhood of $150,000, including the water power plant, and paid for itself in less than two years after it was started. Another cost about $30,000, and the secretary and one of the principal owners of the company, who adopted this plant, told me only a few weeks ago that the saving in the lighting of their operations over the cost of previous methods alone nearly pays the operating expenses, and about 100 h. p. is distributed through various electrical machinery at practically no additional cost over hand work, while the working capacity is increased many times.

There are so many places where power could be transmitted, both over long and short distances, and distributed electrically that unfavorable comparisons with steam should not occur and will not occur when the projects are properly conceived and carried out.

ST. LOUIS, MO. OWEN FORD.

Electrical Progress in Switzerland.

Some interesting developments of electric transmission of power and electric traction, according to the London "Electrician," are now taking place in Switzerland, where the abundance of water power enables electricity to compete with success with every other mode of power transmission. The Compagnie de l'Industrie Electrique, of Geneva, is now actively engaged in building eight electric cars, each fitted with 20-h. p. single reduction motors, for the new line from Champel to Petit Sacconnex, which will pass through the centre of Geneva and will be about 5½ kilometres in length. This line is to be worked on the trolley system, the construction of which is being undertaken by the above-named company. At Dijon it is expected to have four or five different lines of electric tramways running by next summer, and the equipment of 20 cars, of the same pattern as for the Champel-Sacconnex line, is being carried out by the Geneva Electric Company. As regards the utilization of water power, a scheme is under consideration for transmitting 3,000 h. p., taken from the Isere, half to Valence sur Rhone and half to Romans. The available fall is very low, and vertical turbines, making 25 revolutions per minute, are to be erected.

Relation Between Increase of the Dimensions and Rise of Output of Dynamos.—II.*

BY ALFRED E. WIENER.

1. Influence of Size.—In order to determine the influence of the size of the dynamos upon the value of x, let us compare the outputs of four bipolar dynamos, having slotted drum armatures of $d_1 = 5$ inches, $d_2 = 10$ inches, $d_3 = 20$ inches and $d_4 = 30$ inches diameter, respectively.

Let us assume

$l_1 = 8$ inches, then for all four machines, $\alpha = \frac{8}{5} = 1.6$;

$h_1 - 1$ inches, " " " " " $\beta = \frac{1.625}{5} = 0.33$;

$t_1 = \frac{1}{2}$ inch, " " " " " $\delta = \frac{0.5}{5} = 0.1$;

$v_1 = 45$, " " " " " $v = 45$ ft. p. sec.

$\varphi_1 = 135$ deg., " " " " " $\varphi = 135$ deg;

$\sigma_1 = 0.5$, " " " " " $\sigma = 0.5$.

Let us further, for simplification, make the number of

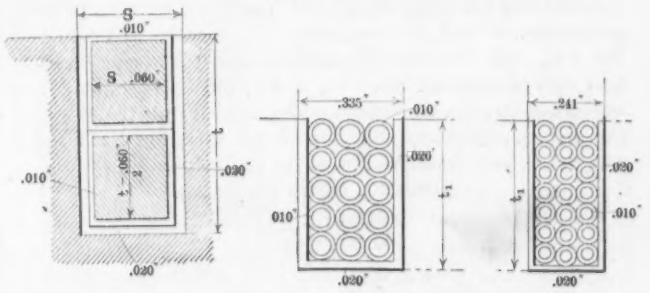


FIG. 2. FIGS. 3 AND 4.

armature slots, and also the number of conductors, proportional to the diameters:

$$n_1 = 24;\ n_2 = 48;\ n_3 = 96;\ n_4 = 144.$$

$$A_1 = 48;\ A_2 = 96,\ A = 192;\ A_4 = 288.$$

If, now, the slots in all four machines are coated with .020 inch insulation, and if the conductors have a covering of .010 inch thickness (each side), then the sectional areas of the conductors can be found from

$$q = \frac{(s-i) \times (t-i_1) \times n}{A} = \frac{(s-.060) \times (t-.060)}{2}.$$

The width of the slot in the present case is the same for all four armatures and is to be obtained by formula (8):

$$s = \frac{5 \times \pi}{24} \times \left(1 - 0.2 - \frac{255 \times 0.33 \times 0.5}{135}\right) =$$

$$\frac{5 \times \pi}{24} \times 0.49 = .32 \text{ inch}.$$

* In the last issue of THE ELECTRICAL WORLD, page 395, the symbol for the saturation factor of pole pieces should have been ρ instead of σ, as it was made by a typographical error.

Therefore:

$$q_1 = \frac{(.32-.06)\times(0.1\,d_1-0.6)}{2}$$

$$= \frac{.26\times.44}{2} = .057 \text{ sq. in.}$$

$$q_2 = \frac{.26\times.94}{2} = .122 \text{ sq. in.}$$

$$q_3 = \frac{.26\times1.94}{2} = .242 \text{ sq. in.}$$

$$q_4 = \frac{.26\times2.94}{2} = .382 \text{ sq. in.}$$

Inserting, now, in (2) the values of S, L and w, for drum armatures,

$$S = d\pi l + 2\times\frac{d^2\pi}{4} = d^2\pi(\alpha+0.5),$$

$$L = l + 1.5\,d = d\times(\alpha+1.5),$$

and $w = 1.75$* watts per square inch, we obtain the following empirical formula for the current strength of any drum armature:

$$C = 1140\times p\times\sqrt{\frac{1.75\times q\times d^2\pi\times(\alpha+0.5)}{A\times d\times(\alpha+1.5)}}$$

$$= 1500\times p\times\sqrt{\frac{\alpha+0.5}{\alpha+1.5}}\times\sqrt{\frac{q\times d}{A}} \text{ ampères.} \quad (15)$$

In our example we have $P = 1$, and $p = 2$, hence we obtain, by formula (11):

$$E_1 = A_1\times d_1\times(.0092\times\alpha\times\beta\times\sigma\times v) =$$

$$48\times5\times0.11 = 26.4 \text{ volts.}$$

$$E_2 = 96\times10\times0.11 = 105 \text{ volts.}$$

$$E_3 = 192\times20\times0.11 = 420 \text{ volts.}$$

$$E_4 = 288\times30\times0.11 = 950 \text{ volts.}$$

and by formula (15):

$$C_1 = 3000\times\sqrt{\frac{2}{3}\frac{1}{1}}\times\sqrt{\frac{q_1\times d_1}{A_1}} =$$

$$2470\times\sqrt{\frac{.057\times5}{48}} = 190 \text{ ampères.}$$

$$C_2 = 2470\times\sqrt{\frac{.122\times10}{96}} = 280 \text{ ampères}$$

$$C_3 = 2470\times\sqrt{\frac{.242\times20}{192}} = 393 \text{ ampères}$$

$$C_4 = 2470\times\sqrt{\frac{.382\times30}{288}} = 495 \text{ ampères.}$$

Therefore:

$$W_1 = 26.4\times190 = 5{,}000 \text{ watts.}$$
$$W_2 = 105\times280 = 29{,}400 \text{ "}$$
$$W_3 = 420\times393 = 165{,}000 \text{ "}$$
$$W_4 = 950\times495 = 470{,}000 \text{ "}$$

By comparison of these values we obtain:

$$\frac{W_4}{W_3} = \left(\frac{d_4}{d_3}\right)^x = (1.5)^x; \text{ or } x = \frac{\log W_4 - \log W_3}{\log\left(\frac{d_4}{d_3}\right)} = 2.58$$

$$\frac{W_2}{W_1} = \left(\frac{d_2}{d_1}\right)^x = (2)^x; \text{ or } x = \frac{0.7693}{0.3010} = 2.56$$

$$\frac{W_4}{W_2} = \left(\frac{d_4}{d_2}\right)^x = (3)^x; \text{ or } x = \frac{1.2038}{0.4771} = 2.53$$

$$\frac{W_3}{W_1} = \left(\frac{d_3}{d_1}\right)^x = (4)^x; \text{ or } x = \frac{1.5185}{0.6021} = 2.53$$

$$\frac{W_4}{W_1} = \left(\frac{d_4}{d_1}\right)^x = (6)^x; \text{ or } x = \frac{1.9731}{0.7782} = 2.53$$

From this it follows that the value of the exponent x, for the ratio of outputs of two dynamos of the same type, decreases with increasing ratio, m, of their linear dimensions.

2. *Influence of Voltage.*—From the considerations already stated, it follows that the value of x must be greater for the comparison of a high voltage dynamo with one wound for low voltage than for the comparison of a low voltage machine with one of high potential. For the purpose of determining the amount of this influence of the ratio of potentials, we will now calculate the outputs of machine No. 1 ($d_1 = 5''$) for 190 volts, and for 370 volts, respectively, and that of machine No. 4 ($d_4 = 30''$) for 50 volts, and 370 volts respectively, and combine the outputs thus found with the values previously determined for machine No. 1 (for 26.4 volts), and machine No. 4 (for 950 volts).

MACHINE NO. 1, FOR 190 VOLTS.

For this potential we need

$$A_1' = \frac{190}{5\times0.11} = 345 \text{ conductors.}$$

If we make the number of slots

$$n_1' = 23,$$

there will be

$$\frac{A_1'}{n_1'} = \frac{345}{23} = 15 \text{ conductors in each slot,}$$

and since

$$S_1' = \frac{5\times\pi}{23}\times0.49 = .335'',$$

and $t_1 = 0.5$,

we have to arrange these 15 conductors as .335 : 5, or in 5 layers of 3 wires each; consequently

$$a_1' = \frac{.335-3\times.020-.040}{3} = .078'',$$

$$t_1' = 5\times.078+5\times.020+.020 = .51'',$$

$$q_1' = \frac{(.078)^2\times\pi}{4} = .0048 \text{ sq. in.,}$$

therefore:

$$C' = 2470\times\sqrt{\frac{.0048\times5}{345}} = 20.5 \text{ ampères.}$$

*Averaged from a great number of practical drum armatures.

and finally,

$$W_1 = 190\times20.5 = 3900 \text{ watts.}$$

MACHINE NO. 1, FOR 370 VOLTS.

$$A_1'' = \frac{370}{5\times0.11} = 672; \; n_1'' = 32$$

$$\frac{A_1'}{n_1''} = \frac{672}{32} = 21 = 3\times7$$

$$S_1'' = \frac{5\times\pi}{32}\times0.49 = .241''$$

$$a'' = \frac{.241-3\times.020-.040}{3} = .047''$$

$$t'' = 7\times(.047+.020)+.020 = .49''$$

$$q_1 = \frac{(.047)^2\times\pi}{4} = .00174 \text{ sq. in.}$$

$$C'' = 2470\times\sqrt{\frac{.00174\times5}{672}} = 9 \text{ ampères.}$$

$$W_1'' = 370\times9 = 3{,}330 \text{ watts.}$$

MACHINE NO. 4, FOR 50 VOLTS.

$$A_4' = \frac{50}{30\times0.11} = 15; \; n_4' = 60.$$

$$S_4' = \frac{30\times\pi}{60}\times0.49 = .77''; \; t_4' = t_4 = 3''$$

$$q_4' = \frac{(.77-0.4)\times(3.0-.02)\times60}{15},$$

$$= 4\times.73\times2.98 = 8.9 \text{ sq. ins.}$$

$$C_4' = 2470\times\sqrt{\frac{8.9\times30}{15}} = 10{,}400 \text{ ampères.}$$

$$W_4' = 50\times10400 = 520{,}000 \text{ watts.}$$

MACHINE NO. 4, FOR 370 VOLTS.

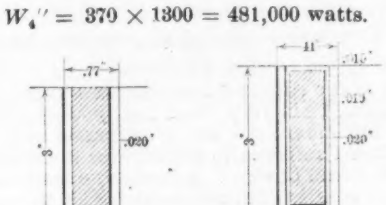
$$A'' = \frac{370}{30\times0.11} = 112; \; n_4'' = 112.$$

$$S_4' = \frac{30\times\pi}{112}\times0.49 = .41; \; t_4'' = t_4 = 3''.$$

$$q_4' = (.41-.06)\times(3.0-.04),$$
$$= .35\times2.96 = 1.036 \text{ sq. ins.}$$

$$C_4' = 2470\times\sqrt{\frac{1.036\times30}{112}} = 1{,}300 \text{ ampères.}$$

$$W_4'' = 370\times1300 = 481{,}000 \text{ watts.}$$



FIGS. 5 AND 6.

From these figures we obtain, for the various ratios of potentials, the following values of the exponent x:

Ratio of potentials.	
$\frac{50}{370} \sim \frac{1}{7.5}$	$x = \frac{\log W_4' - \log W_1''}{\log d_4 - \log d_1} = \frac{2.1936}{0.7782} = 2.82.$
$\frac{50}{190} \sim \frac{1}{4}$	$x = \frac{\log W_4' - \log W_1'}{\log d_4 - \log d_1} = \frac{2.1249}{0.7782} = 2.73.$
$\frac{370}{370} = 1.$	$x = \frac{\log W_4'' - \log W_1''}{\log d_4 - \log d_1} = \frac{2.1597}{0.7782} = 2.77.$
$\frac{370}{190} \sim 2.$	$x = \frac{\log W_4'' - \log W_1'}{\log d_4 - \log d_1} = \frac{2.0910}{0.7782} = 2.69.$
$\frac{950}{190} = 5.$	$x = \frac{\log W_4 - \log W_1'}{\log d_4 - \log d_1} = \frac{2.0810}{0.7782} = 2.67.$
$\frac{370}{26.4} = 14.$	$x = \frac{\log W_4'' - \log W_1}{\log d_4 - \log d_1} = \frac{1.9831}{0.7782} = 2.55.$
$\frac{950}{26.4} = 36$	$x = \frac{\log W_4 - \log W_1}{\log d_4 - \log d_1} = \frac{1.9731}{0.7782} = 2.53.$

From this it is evident that, for the comparison of the same two machines, the exponent x decreases as the ratio of their voltages increases.

With the aid of the preceding examples as well as of numerous other calculations, I have arranged a little table, giving the average values of the exponent x for all the various combinations of size and voltage:

Ratio of Potentials.	Ratio of Linear Dimensions. $\frac{d_2}{d_1} > 1$, < 2	$\frac{d_2}{d_1} > 3$, < 8	$\frac{d_2}{d_1} > 8$
	Value of Exponent x.		
$\frac{E_2}{E_1} < \frac{1}{6}$	3.00	2.85	2.70
$\frac{E_2}{E_1} > \frac{1}{4}$	2.80	2.70	2.60
$\frac{E_2}{E_1} < 4$	2.60	2.55	2.50
$\frac{E_2}{E_1} > 10$			

This table I have checked on actual machines of various types, and, from the good results obtained, trust that it can be advantageously used in practical dynamo calculation.

II. Comparison of Dynamos of Different Type.—Since formulæ (11) and (12) apply to any dynamo, bipolar as well as multipolar type, and ring as well as drum armature, the preceding considerations, and therefore also the values given in the above table, hold good for the comparison of any two machines of the same type. We will now consider the case of the comparison of two machines of different type, particularly that of comparison of multipolar with bipolar machines.

If the same armature is used for both a bipolar and a multipolar machine of the same total magnetic flux, $M_m \times P = M$, and run with the same conductor velocity v, then, since $p = 2$ for the bipolar type, the E. M. F. of the multipolar machine, as follows from formula (1), is:

$$E_m = \frac{E}{2p},$$

and the current strength, in consequence of formula (2), :

$$C_m = 2p\times C.$$

The output of the multipolar type, therefore, is, for like conditions of the two machines equal to that of the bipolar:

$$W_m = E_m\times C_m = \frac{E}{2p}\times2p\times C = E\times C = W. \quad (16)$$

But since in a dynamo with P pairs of poles there are $2P$ parallel magnetic circuits through the armature, we have for the armature saturation factor of a multipolar machine

$$\sigma_m = \frac{M_m\times P}{2P\times l\times h\times120000} = \frac{1}{P}\times\frac{M}{2\times l\times h\times120000} = \frac{\sigma}{P} \quad (17)$$

If, therefore, the same armature is run with the same velocity in machines of different type, but all having the same total flux, its saturation decreases with increasing number of poles, and, numerically, is equal to the bipolar saturation, divided by the number of pairs of poles.

In the case, however, that the armature in the two types has different conductor velocities, v and v', respectively, we can still, according to formula (1), obtain the same E. M. F., and consequently the same output, if we only make the product of speed and magnetic flux the same for both types. But a change in the flux alters the saturation of the armature, hence in order to obtain the same output for different speeds the armature saturation is to be taken in inverse proportion to the conductor velocities.

$$\sigma_m' = \sigma_m\times\frac{v}{v'} = \frac{\sigma}{P}\times\frac{v}{v'}. \quad (18)$$

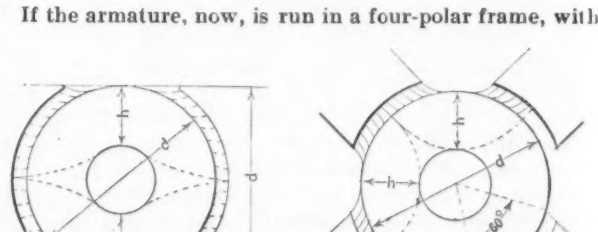
This, however, can only be done within certain limits; the upper limit of the speed is determined by the maximum conductor velocity that must not be surpassed, while the lower limit is reached when the saturation of the pole pieces, owing to the increased flux necessary to obtain the same output at a smaller conductor velocity, has attained its practical limit.

Let, for instance, the saturation factor of an armature of diameter d, and radial depth $h = 0.33\,d$, at its maximum conductor velocity of $v = 50$ feet per second, be $\sigma = 0.5$ if running in a bipolar machine. Then the saturation factor of the pole pieces, assuming they are of cast iron, is:

$$\rho = \frac{\text{Flux per pole}}{\text{Pole section}\times75000} = \frac{2\times l\times h\times120000\times\sigma}{d\times l\times75000} =$$

$$\frac{2\times0.33\times120000\times0.5}{75000} = .53.$$

If the armature, now, is run in a four-polar frame, with



FIGS. 7 AND 8.

a conductor velocity of $v' = 40$ feet per second, then its saturation, according to (18), will be:

$$\sigma_m = \frac{0.5}{2}\times\frac{50}{40} = .31,$$

if the flux is increased proportional to the decrease of speed.

The pole pieces, consequently, will be saturated to a degree of

$$\rho_m' = \frac{2\times.33\,d\times120000\times.31}{0.5\,d\times75000} = .65.$$

For $v' = 35$ feet per second, finally, the armature saturation at the same output is:

$$\sigma_m'' = 0.25\times\frac{50}{35} = .36,$$

and the corresponding saturation of the pole pieces

$$\rho_m'' = \frac{2\times0.33\times120000\times.36}{0.5\times75000} = .76.$$

Here we have reached the minimum speed for which we yet can obtain the same output as for maximum conductor velocity, for it would not be advisable to exceed this density of $75000\times.76 = 57{,}000$ lines per square inch in cast iron.

From this example it follows that multipolar machines, under like conditions, have the same output as bipolar ones, and that a variation of the speed in certain practical limits (in one case within 43 per cent.) has no influence upon the output, provided that the saturation is altered accordingly.

Then further it follows that the values given in the foregoing table, besides for the comparison of machines of the same type, also stand good for the comparison of the outputs of dynamos of different type, if any difference in the conductor velocity is properly considered.

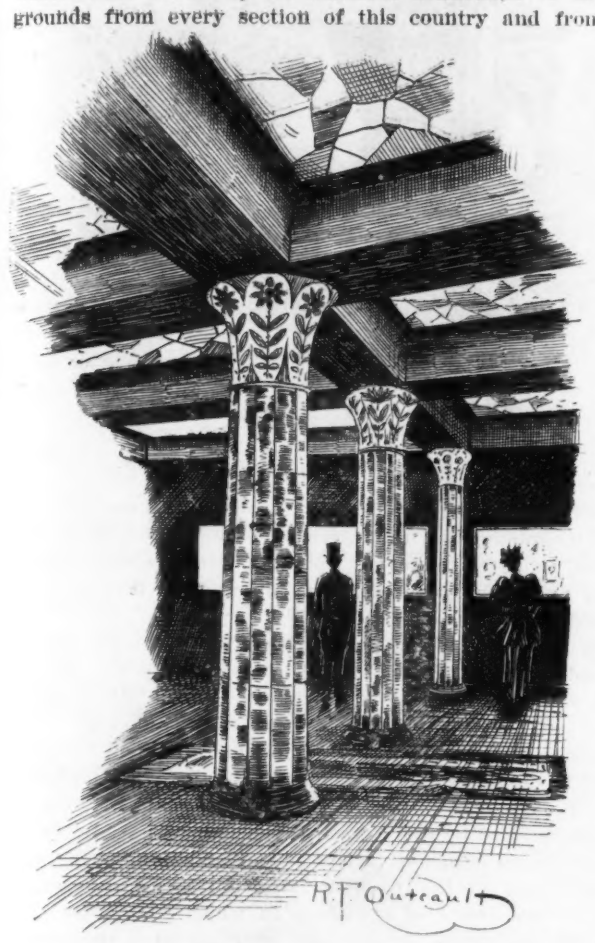
Electricity at the World's Fair 1893

SOME ARTISTIC FEATURES OF ELECTRICAL EXHIBITS

RETROSPECTIVE SOLARING

BY RICHARD FELTON OUTCAULT.

The World's Columbian Exposition, which has so recently been brought to a close, in all the wide influences which it exerted over the millions of visitors which were drawn by its manifold attractions to the grounds from every section of this country and from



INTERIOR OF WESTERN ELECTRIC TEMPLE.

almost every quarter of the world, left no deeper impression than that of its unqualified success as an artistic creation. This was the one feature in which its superiority over all previous exhibitions was universally acknowledged. The beauty of the natural situation and the dignity, grandeur and harmony of the buildings combined to delight and to charm, and created an impression on the mind that will prove to be lasting when many of the minor details of the White City shall have faded from memory.

This elevating artistic influence was not only felt when surveying the Fair as a whole, but it permeated every section, and the humblest exhibit contributed its share to this result in a more modest but not less effective way than the great picture gallery, the many groups of statuary or the other features which, strictly speaking, might be considered to form the art exhibit

DETAIL OF THE PAGE EXHIBIT.

proper. From the first the exhibitors realized the wisdom, if not the necessity, of making displays that were attractive and in harmony with the surroundings, and no expense was spared to secure this result.

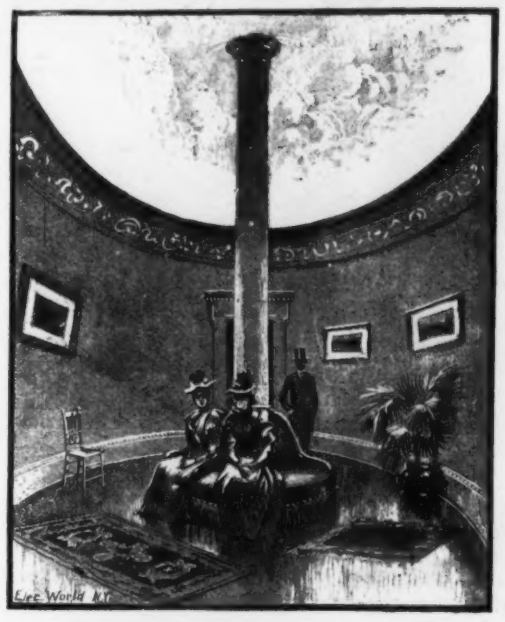
Among all the buildings few proved to have greater attractions or to contain more interesting and tasteful displays than that which had been set apart for the department of electricity. It is perhaps difficult to perceive how exhibits naturally so prosaic or inartistic as the products of our great mechanical and industrial firms could be arranged in any pleasing or attractive way. To those, however, who have glanced through the advertising pages of our great magazines and have found themselves reading with interest the announcements made there, this does not seem so strange. The cleverness with which these various advertisements are presented is unquestionably the secret of their success. It may be said with truth that so much attention has not been paid to advertising announcements in our class journals and magazines, among which may be included those devoted especially to the practice and science of electricity, but this is no doubt due to the fact that development in these fields being so rapid the advertising partakes more nearly of the character of news, and is the more eagerly sought by the readers, and also to the fact that the readers are more directly interested and intimately connected with the commercial side of the industry. At the World's Fair, however, the electrical manufacturing companies, as well as those of kindred interests, rivalled the older firms in the beauty and quality of their displays, and the throngs of visitors which con-

ENTRANCE TO SCIENCE THEATRE.

tinually crowded Electricity Building proved the wisdom of their action.

It is difficult to call attention to the artistic features of any special exhibit, when the general excellence of the displays was so high. Everything that good taste could suggest was brought into play. Most of the companies, realizing that with the multitude the frame is half the picture, surrounded their exhibits with elaborate and costly decorative effects to gain the attention of the spectator. Some built pavilions or booths, others arranged rich backgrounds or sought to beautify their spaces with electric lighting effects, while some arranged their wares in quaint designs. But whatever means were employed, all accomplished the same successful end. The combined effect of all this decoration made Electricity Building very beautiful as a whole, as all who had the pleasure of seeing it must admit.

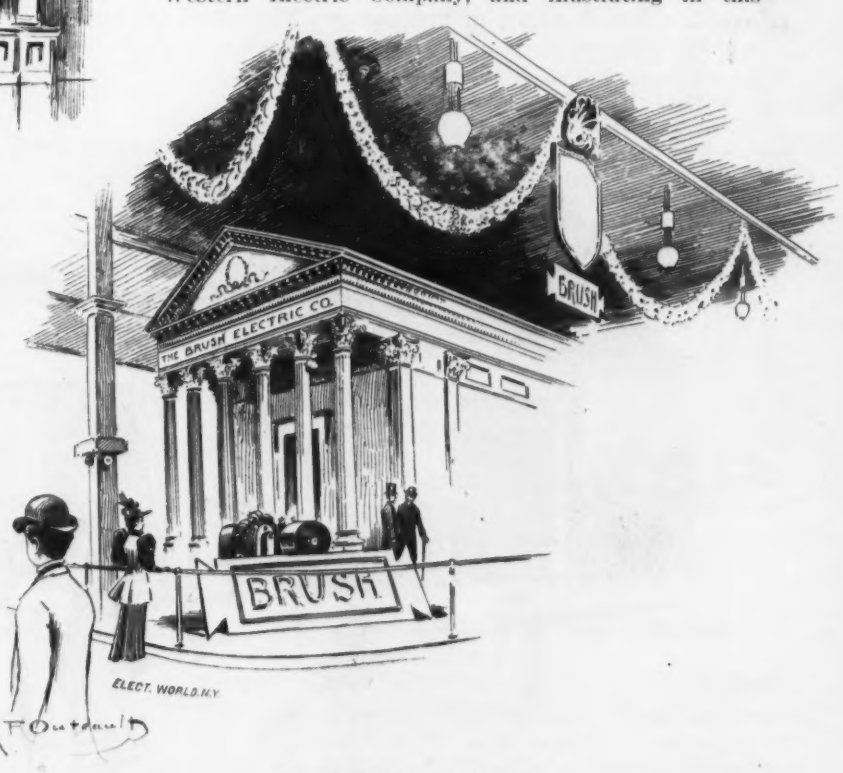
In most cases the exhibitors placed on exhibition specimens of their standard apparatus in working order and did not attempt to engage the visitor's attention or admiration with varnish and polished metal. The decoration was simply as a background to cover the unsightly rafters and posts of the interior of Electricity Building. It is to be regretted that this building, so stately and beautiful on its exterior, should have contained so many crude and homely posts and joists which might have been covered or otherwise treated to aid the exhibitor in making a more presentable disply. This was done in the Paris exhibition of 1889, in buildings made of wood, and the consequence was a much more beautiful



INTERIOR OF THE BRUSH PAVILION.

interior. Photographs of the electrical exhibits usually represented 25 per cent. exhibit and 75 per cent. rafters, posts and lumber, and this was one of the reasons why The Electrical World made use of sketches in preference to photographs.

One of the many artistic features of the electrical exhibits was the Temple of the Western Electric Company, which was located in the southeast corner of the building. This structure was of a pure Egyptian style and reflected great credit on its designer as a student of Egyptian architecture. Its exterior, which for its simplicity might have been rather too severe, was made highly interesting with the story that was told by a number of figures all represented as engaged in some portion of the work of manufacturing apparatus of the Western Electric Company, and illustrating in this



THE BRUSH PAVILION.

beautiful way the use of all their products. So clever was the imitation in this case that one might easily fancy he was in the presence of a real specimen of ancient Egyptian handiwork. The interior of this structure was a beautiful illustration of what can be accomplished in lighting effects. Massive pillars, presumably to support the roof of this temple, were made of dark green glass, inside of which were placed electric lights at frequent intervals, and the effect at first sight was that of heavy mottled plush. A closer look, however, proved that a rich, mellow light streamed from them, and shed a pleasing glow on everything. The capitals of these

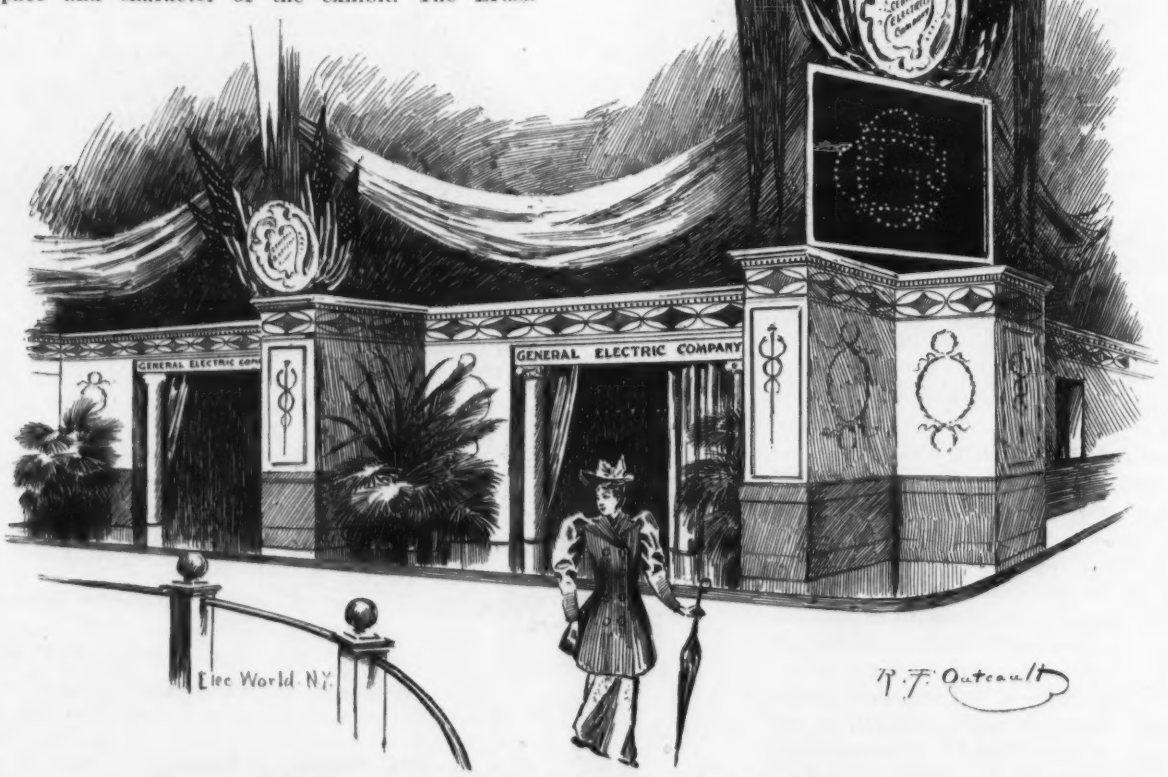
columns were of stained glass of harmonious colors. The ceiling, as seen in our illustration, was handled the same way, being made of colored glass through which shone electric lights. This interior was an example of what a dining-room or ball-room might be with a similar system of lighting, and it is difficult to see why

A Corner of the Munson Display.

such schemes of illumination for residences have not been adopted by our decorators and architects, as more charming decorative effects could not possibly be obtained. Aside from the lighting of this temple, it was also used as an exhibition room. Around the walls of the two rooms, about on a line with the eye, were cases sunk into the walls and covered with glass. Concealed lights shed a soft glow into the cases, which contained nearly every small article in the way of telegraph, telephone and switchboard apparatus manufactured by this company.

The scenic theatre, which has already been most elaborately described in these columns (see The Electrical World, June 24, 1893), was also an admirable illustration of artistic decorative effects.

While the Western Electric Company had chosen the Egyptian type to best serve their purpose, other companies had carried out their own ideas, some preferring the Moorish style of architecture, some the stately Roman or classic Greek, but all were selected to best fit the space and character of the exhibit. The Brush



A Feature of the General Electric Exhibit.

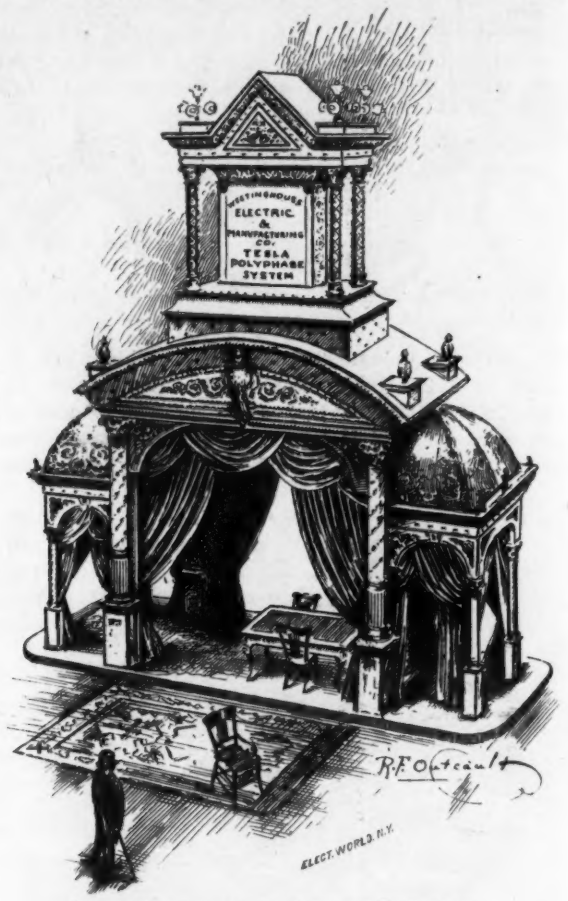
Electric Company, together with the Sperry and Short Electric Railway companies, occupied a very large space in the southwestern corner of the building, and here they also erected a temple, the interior of which was used to produce lighting effects.

The exterior was purely classic, dignified and handsome. It was built of wood, covered with staff, and painted white to resemble white marble. The interior was a room of fair size, the ceiling of which was a rounded dome decorated wth a representation of a blue sky, across which a few white feathery clouds were passing. The cornice, or frieze, concealed the lights from view, but as they shed their brilliant rays on the dome it in turn reflected the greater portion of the light into the room. In this novel way there was not a shadow, for every nook and corner was evenly lighted. No glare offended the eye, although there was an abundance of light, and one was pleased and soothed by it, as in a room lighted by sky-light from above; indeed, the imitation of daylight was quite perfect. In our illustration of the exterior of this temple it will be noticed that a cornice was placed around the whole exhibit, and that from this cornice garlands made of staff and painted white were hung one after the other around the whole space. Between these were suspended arc lamps and occasionally a

An Effective Use of Bunting.

small tablet, of a shield, bearing a legend in letters of gold that instructed the visitor in regard to the display of dynamos, motors or street railway apparatus. This whole display was as handsome as white and gold and good taste in arrangement could make it.

In the centre of Electricity Building stood the exhibit of the General Electric Company, the gigantic proportions of which give it great prominence. We illustrate one of the four corners of this space, an inclosure used as a reception room, office, etc. It was very richly furnished, and its walls were decorated with designs in miniature electric lamps, while gorgeous fixtures manufactured by this company were suspended from the ceiling and illustrated what the General company was doing in this line. On its exterior the frieze was dotted with colored lights that glittered and sparkled, emphasizing the outline of the design. Great groups of palms and tropical plants were massed together in corners and odd nooks about the great exhibit, and served to break the hard, straight lines, and add another bit of color to the brilliant interior of Electricity Building. Flags and bunting were used here to good effect, and did their share toward beautifying the surroundings. This was one form of decoration that was not overdone, as has often been the case in such



The Westinghouse Golden Pavilion.

exhibitions. Flags and banners are beautiful and effective in ornamenting the interiors of buildings, but when used to cover tables or counters, wrap about posts and put over and under everything, they become decidedly monotonous.

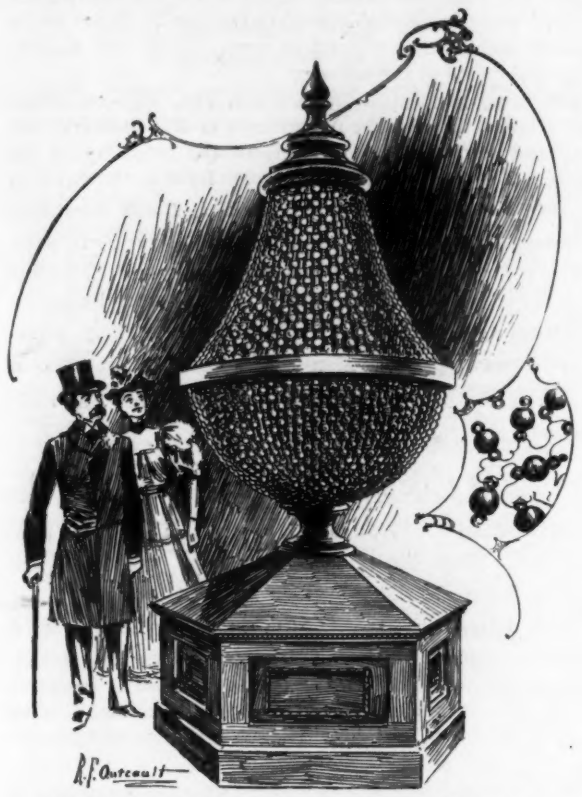
In the centre of the General Electric Company's space stood the great Tower of Light, described in The Electrical World of April 8, and subsequent isues. Surrounding the base of this was a pavilion occupied by the Phoenix Glass Company, of simple and dignified design, and in decidedly good taste. The dainty white shelves in this exhibit were loaded with the beautiful glassware manufactured by this company, consisting of shades and globes in an immense variety of exquisite designs. From the ceiling of the pavilion hung a number of costly globes and bowls of cut glass, in which were hung incandescent lamps, whose light sparkled in a thousand brilliant hues, as it streamed through the daintily carved designs in the glass. This display was a decoration in itself, and added much to the general effect of the building.

Just to the north of the General Electric Company was one of the spaces occupied by the Westinghouse Electric and Manufacturing Company, in the centre of which was a beautiful golden pavilion, which as an ornamental affair was unique. Its golden decoration was brightened and its beauty enhanced by the electric bulbs that outlined it from top to bottom and emphasized every line. Our illustration gives an excellent idea of

A Bit of the Ansonia Moorish Pavilion.

if looking from the north gallery. This pavilion was surrounded by the well known Westinghouse apparatus. One can scarcely realize the value of a structure of this kind in exhibition work. It adds tone and life to the articles shown, it attracts the spectator, and does its part toward enlivening the whole interior. It was of course, not expected that all the visitors to such a fair would be electrical people, or would have a knowledge of electricity. The great majority are merely sight seers who come to be amused or gratified by the sight of something beautiful and pleasing, and they must be entertained.

From the main floor of the building looking upward one could plainly see stretched across the northern end of the gallery an extensive pavilion of still another style of architecture from any that we have thus far noticed. It was of the gorgeous Moorish type, and of tremendous proportions. Here the Ansonia Electric Company displayed its wares, together with those of



A PROMINENT FEATURE OF THE JOHNS DISPLAY.

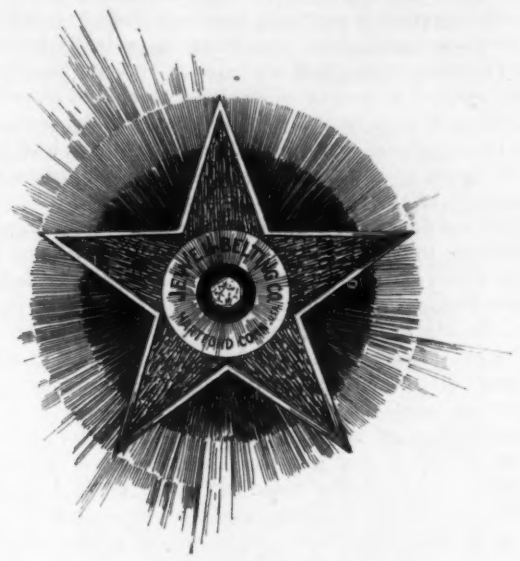
many other companies of which it is the representative. Our illustration shows but a bit of detail from one end of it, and gives an excellent impression of what its character was.

In strolling about the gallery one came upon very many beautiful displays, an especially attractive one being that of the H. W. Johns Manufacturing Company. We illustrate one of the most interesting features in their exhibit in the shape of a tremendous vase or urn made of molded mica globe strain insulators supported by an oak stand. Had these small insulators been arranged in any other way, or presented on a sample board, or in a case, they could not possibly have attracted such attention, or served to ornament the exhibit. When, as in this case, the character of the wares is considered, the ingenuity displayed is surprising. Colored lamps are always pretty if arranged with a view to harmony, and this had been done in the sign hanging over this space. This consisted of large letters, 24 inches in height, made up of white frosted and red lamps. First, the white lamps proclaimed to those in all parts of the building the location of the H. W. Johns Manufacturing Company, and then the red stated plainly in one word that insulation was the main product of the firm.

ENTRANCE TO PAVILION OF EUREKA TEMPERED COPPER COMPANY.

Hard by, indeed, but a few steps away, was another pretty pavilion in very pure Moorish design, and it was seen by the legend over the doorway that the Eureka Tempered Copper Company had ensconsed itself within this mosque and was prepared to entertain friends and instruct the public in general regarding the temper of copper for electrical work.

Did space but permit one might find a bit of artistic effect or picturesque touch in nearly every display, but only a few of the more prominent ones have been noticed in order to show to what an extent our electrical companies have realized the importance of attractively



AN EFFECTIVE DESIGN.

presenting their goods, though involving the expenditure of considerable sums of money for purely decorative purposes.

Electricity on the Canals.

A public trial was held on Saturday, Nov. 18, of an electric trolley system for canal-boat propulsion at Brighton, near Rochester, N. Y., in the presence of Governor Flower, Nikola Tesla, George Westinghouse, Jr., and a number of public officials, capitalists and others.

The Westinghouse company furnished the apparatus and paid one-half the expense of the experiment, the State paying the remainder, the entire cost being $5,000. The electrical power was obtained from the Rochester Railway Company and was supplied to the boats by means of a flexible trolley system; the boat used was an old steam canal-boat, from which the engine and boiler had been removed, and a large Westinghouse motor connected to the propeller shaft. The connecting wires ran from the motor up to two trolley standards of the same design as those used on street cars, one being for the return current. By the side of the steering wheel of the boat is a switchboard, which is so placed as to enable the steersman to control the electrical power as he pleases.

Several thousand spectators had assembled on the banks of the canal to witness the experiment. Governor Flower was escorted aboard the boat, accompanied by a large number of invited guests, and took his position at the switchboard; after some delay the canal-boat was finally, by means of a tug, placed in position under the trolley wire, and the Governor turned on the current.

The boat moved forward with surprising smoothness, and gained in speed until it moved at the rate of four miles an hour, the machinery working smoothly and the water astern being churned up very little. The boat passed along the canal for half a mile, turning curves, going under a bridge, and in and out of a lock.

The Governor was highly pleased with the experiment, and said in response to a demand for a speech:

"The test has resulted well, but of course we will have more of them. I am satisfied that with better apparatus and improved facilities an average speed of four miles an hour can be attained here on the canal. With horses but two miles an hour can be made. I am informed by the electricians that the expense of operating a boat by electricity will be about one-half that of steam. I think we shall see the boats on the Erie operated by this magic power before many years. One of the economies will be the abolition of the towpath. The canal now costs this State $1,000,000 a year; nearly all that is expended in keeping the towpath in good condition.

"In 1829, when De Witt Clinton started from Buffalo for Albany on a canal-boat, he had a military company as an escort, but there was no electricity to move boats or transmit news. They sent the fact of his starting from Buffalo to New York by the successive discharges of cannons along the bank of the canal and the Hudson River, and the time occupied in sending the message from Buffalo to Sandy Hook was one hour and 50 minutes. The people gathered along the canal rejoicing at the improvement. Forty tons of freight was all that was taken from Buffalo to New York the first season the canal was operated. Now 3,000,000 tons a day goes through. By the use of electricity as a motive power the tonnage may be increased to 12,000,000 daily without any cost to the people of the State. When canal-boats shall all be propelled by electricity the horse and the mule will be given a rest, and the greatest medium for transporting the immense products of the West to the Atlantic, greater than the Canadian Canal or the Mississippi River, will be the Erie Canal. I consider it a great privilege to witness this test as Governor of the State of New York, because I regard this successful demonstration that boats can be propelled by electricity as important an epoch in the commercial history of the State as was the opening of the Erie Canal. If the electricians are correct in their estimates, the expense of running boats on the Erie Canal will be reduced to one-fourth or one-fifth of the present cost."

Mr. Westinghouse, commenting upon the economy of running the electric canal-boats, said: "I understand that eight men are now required to run canal-boats. An electric canal-boat will only require two men—one to run the boat at night and one in the day. Moreover, space will be saved, for there need not be any place left for stables for the horses or mules."

More Data on Traction Experiments.

BY ELMER A. SPERRY.

Since compiling the paper on "Traction and Street Railway Trucks," presented at the Milwaukee meeting of the American Street Railway Association, further experiments have been undertaken, verifying fully the results given in the communication as presented at Milwaukee, and, in addition, other facts have been learned, one of which in particular may be of interest. Without going fully into the details of the experiments the results may be given as follows:

It has been discovered that the nature of the coupling from one axle to another determines the amount of useful effect, appearing as drawbar pull, as stated in the paper, but to a very much larger extent than was at first supposed. The coupling from one axle to the other must be perfectly rigid and metallic; that is, no cushions or springs are allowable; in fact, nothing should be used to couple the drivers which will yield or allow one driver to move even in the slightest unless the other is compelled to make a corresponding movement whereby the shearing of the minute teeth is prevented, the interlocking of which teeth constitute adhesion. The experiments emphasize a statement made in the paper to the effect that preventing the start to slip is the critical point, and that the harmony of motion of the drivers must be absolute; an approximate harmony is not sufficient for the purpose. The difference between a rigid connection and one which is of a yielding nature is very marked, the readings in drawbar pull taken with a yielding connection being almost as low as with independent motors. It is of interest to note in this connection the great wisdom exercised by locomotive builders in the form of connection which they have finally adopted as standard, and it has been suggested by one who witnessed the results of these experiments that they doubtless "wrought better than they knew." The latest series of these experiments to determine the relative value of connections between the axles wherein springs, cushions or other yielding medium was employed as a part on the one hand, and rigid connections on the other, has proved conclusively that for the best or even good results in traction, the connection between the axles or wheels should be metallic and non-yielding; anything like a spring or cushion should be entirely eliminated therefrom.

In view of the care exercised in these tests and the pronounced character of the results obtained, the last paragraph in my paper should be changed to read as follows:

"While working upon a level, and especially in damp weather with a slimy rail, almost the same advantage in traction will be found to exist as is here given for coupled wheels working on grades, provided always the mechanism used affords on the one hand a perfectly unyielding metallic coupling, while on the other it does not interfere in the least with the flexibility of the truck."

Theory of the Transformer.—VIII.*†

BY FREDERICK BEDELL AND ALBERT C. CREHORE.

DIAGRAM FOR TRANSFORMER WITH MAGNETIC LEAKAGE.

From the principles of the magnetic circuit established in the earlier articles of this series and the values of the coefficients of induction in terms of the reluctances and the number of primary and secondary turns, developed in the preceding article, we may take up the problem of a transformer with constant primary current and magnetic leakage and construct synthetically the corresponding polar diagram.

Referring to Fig. 25 and retaining the same lettering as that used throughout the former articles, namely, as in Fig. 4, Article III., and in Fig. 5, Article IV., we have $\overline{OA}$ the constant primary current. Ninety degrees behind $\overline{OA}$ is $\overline{OB}$, the impressed E. M. F upon the secondary. This is equal to $M \omega I_1$ and is thus a constant. The secondary

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†For previous section of this article, see THE ELECTRICAL WORLD Nov. 18, 1893.

E. M. F. locus is formed by the variation of the right triangle $O\,B\,C$ upon the constant hypotenuse $\overline{O\,B}$, and is therefore a semi-circle $O\ C\ B$. The secondary current locus will then be the locus $O\,D\,L$, a semi-circle upon $\overline{O\,L}$ as diameter. The value of $\overline{O\,L}$ has been shown to be equal to $\frac{M}{L_2} I_1$ and is thus a constant quantity. Formerly, when the transformer was supposed to have no leak and no external self-induction, $\frac{M}{L_2} I_1$ reduced to $\frac{S_1}{S_2} I_1$; but now, by

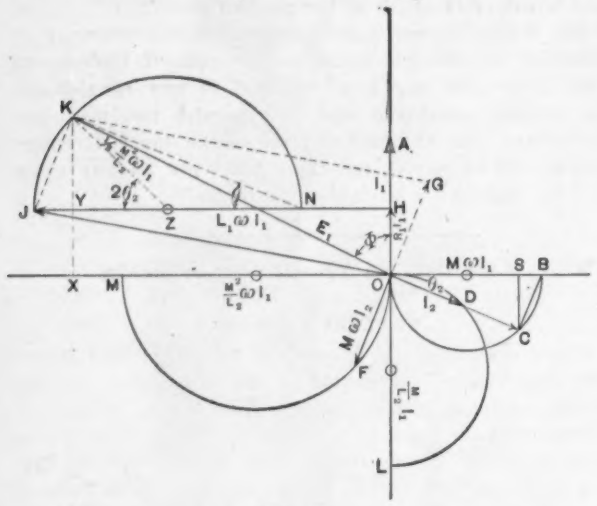


FIG. 25.

referring to the values of these coefficients in equations (103) and (104), we have:

$$\overline{O\,L} = \frac{M}{L_2} I_1 = \frac{S_1\,\mathfrak{R}_2}{S_2\,(\mathfrak{R}_1 + \mathfrak{R}_2)} I_1 < \frac{S_1}{S_2} I_1. \quad (107)$$

Thus $\overline{O\,L}$ is less than formerly on account of the leakage. As $\mathfrak{R}_2$, the reluctance of the leakage branch, increases, the ratio $\frac{\mathfrak{R}_2}{\mathfrak{R}_1 + \mathfrak{R}_2}$ approaches unity and $\overline{O\,L}$ approaches the value $S_1/S_2\,I_1$ which it has in case of no leak.

The back E. M. F. upon the primary is always 90 degrees behind the secondary current and equal to it multiplied by $M\,\omega$. Hence its locus is a semi-circle $O\,F\,M$ upon a diameter $\overline{O\,M}$, 90 degrees behind $\overline{O\,L}$ and equal to $\overline{O\,L}$ multiplied by $M\,\omega$. Therefore we have:

$$\overline{O\,M} = M\,\omega\,\overline{O\,L} = \frac{M^2}{L_2}\,\omega\,I_1. \quad (108)$$

In case of no leak $M^2 = L_1\,L_2$, so that $\overline{O\,M}$ was equal to $L_1\,\omega\,I_1$, the primary E. M. F. of self-induction represented by $\overline{H\,J}$. But in the present case we have:

$$\overline{O\,M} = \frac{M^2}{L_2}\,\omega\,I_1 = \frac{4\,\pi\,S_1^2\,\mathfrak{R}_2^2}{10\,(\mathfrak{R}_1 + \mathfrak{R}_2)\,P}\,\omega\,I_1. \quad (109)$$

Comparing this with the value of $\overline{H\,J}$, viz.:

$$\overline{H\,J} = L_1\,\omega\,I_1 = \frac{4\,\pi\,S_1^2\,(\mathfrak{R}_2 + \mathfrak{R}_3)}{10\,P}\,\omega\,I_1, \quad (110)$$

we have the ratio

$$\frac{\overline{H\,J}}{\overline{O\,M}} = \frac{L_1\,\omega\,I_1}{\frac{M^2}{L_2}\,\omega\,I_1} = \frac{L_1\,L_2}{M^2} = \frac{(\mathfrak{R}_1 + \mathfrak{R}_2)(\mathfrak{R}_2 + \mathfrak{R}_3)}{\mathfrak{R}_2^2} = 1 + \frac{P}{\mathfrak{R}_2^2}. \quad (111)$$

As the sign of the fraction $\frac{P}{\mathfrak{R}_2^2}$ is always positive, it follows that $\overline{H\,J}$ is always equal to or greater than $\overline{O\,M}$. When $\mathfrak{R}_2$ becomes very large the value of the fraction $\frac{P}{\mathfrak{R}_2^2}$ approaches zero, for $\mathfrak{R}_2$ only enters in the first power of any term in the numerator, while it has the second power in the denominator. This shows that the back electromotive force locus is a semi-circle $O\,F\,M$, whose diameter $\overline{O\,M}$ is less than $\overline{H\,J}$.

The primary E. M. F. locus is found directly, when the back E. M. F. is known, by adding together the E. M. F. to overcome the primary self-induction $\overline{H\,J}$, and that to overcome the primary resistance $\overline{O\,H}$, and that to overcome the back E. M. F. $\overline{O\,G}$. Thus we find the primary E. M. F. locus to be a semi-circle $J\,K\,N$, whose diameter $\overline{J\,N}$ is equal to $\overline{O\,M}$. The circle lies to the left of the origin O, as it did in the case previously discussed, where the secondary circuit contained external self-induction. In fact, the typical figure in the two cases is the same. This is as we should expect, since external self-induction in the secondary circuit can be considered as producing the same effect as magnetic leakage; for in either case the induction generated by the primary does not all pass through the secondary; and, *vice versa*, all the induction caused by the secondary current does not thread the primary; thus there is practically magnetic leakage when there is external self-induction. However, the magnitudes of the lines in each diagram are expressed in different terms.

IDENTIFICATION OF GRAPHICAL AND ANALYTICAL RESULTS.

Having constructed the diagram by the synthetic process, it is next in order to inquire whether the diagram thus built up agrees with the analytical expressions obtained from the differential equations mentioned above (See the previous section of this article.) The expressions obtained from the differential equations may not apparently be identical with those obtained directly from the diagram, and sometimes a transformation is necessary. And here we cannot fail to observe the superiority of the graphical diagram in picturing to the eye just what changes are introduced and how the different parts are related, above the ordinary method of analysis. It seems that there is great need of a system of analysis which will represent upon the face of it, as clearly as the diagrams do, just how the variation of one quantity affects the others, and does not, by means of the transformations involved, cause one to lose sight of the real nature of those changes.

We do not doubt but that the methods of vector algebra can be made to do this which is so much desired, and we wish to direct the reader's attention to a paper read before the International Electrical Congress at Chicago by Prof. Alexander Macfarlane relating to the application of vector algebra to this very subject, and express a hope that more attention will in the future be directed toward the developed ment of this subject by means of vector methods.

Identification of Angular Relations.—In order to identify the analytical and graphical results, we will first obtain by each method the value of Φ, the angle between the primary current and impressed electromotive force.

From the analytical results, equation (66), in the previous article, this angle is:

$$\Phi = \text{arc tan}\,\frac{\beta}{\alpha} + \text{arc tan}\,\frac{L_2\,\omega}{R_2}$$

$$\text{Hence,} \quad \tan\Phi = \frac{\frac{\beta}{\alpha} + \frac{L_2\,\omega}{R_2}}{1 - \frac{\beta\,L_2\,\omega}{\alpha\,R_2}} = \frac{\beta\,R_2 + \alpha\,L_2\,\omega}{\alpha R_2 - \beta\,L_2\,\omega} \quad (112)$$

From (67) and (68) we have the values for α and β:

$$\alpha = \omega^4\,(L_1\,L_2 - M^2) - \omega^2\,R_1\,R_2;$$
$$\beta = \omega^3\,(R_1\,L_2 + R_2\,L_1).$$

By substitution of α and β in (112) we have

$$\tan\Phi = -\frac{R_2^2\,L_1\,\omega + L_1\,L_2^2\,\omega^3 - M^2\,L_2\,\omega^3}{R_1\,R_2^2 + R_1\,L_2^2\,\omega + M^2\,R_2\,\omega}. \quad (113)$$

This is the value of the angle between primary current and E. M. F. obtained by purely analytical processes.

Let us now consider the geometrical relation shown in Fig. 25.

$$\text{Tan}\,\Phi = \tan X\,K\,O = \frac{\overline{O\,X}}{\overline{X\,K}} = \frac{\overline{H\,J} - \overline{J\,Y}}{\overline{O\,H} + \overline{Y\,K}}. \quad (114)$$

We know that $\overline{H\,J} = L_1\,\omega I_1$; $\overline{O\,H} = R_1\,I_1$. It remains to determine $\overline{J\,Y}$ and $\overline{Y\,K}$. The triangle $J\,K\,N$ is similar to the triangle $\overline{B\,C\,O}$, and is equal to it multiplied by $\frac{M}{L_2}$, which is the ratio of $\overline{N\,J}$ or $\overline{O\,M}$ to $\overline{O\,B}$.

$$\overline{J\,Y} = \frac{M}{L_2} \cdot \overline{B\,S} = \frac{M}{L_2} \cdot L\,L_2\,\omega I_2 \cdot \sin\theta_2 = M\,\omega\,I_2\,\frac{L_2\,\omega}{J_2}. \quad (115)$$

$$\overline{Y\,K} = \frac{M}{L_2} \cdot \overline{S\,C} = \frac{M}{L_2} \cdot R_2\,I_2. \quad \sin\theta_2 = M\,\omega\,I_2\,\frac{R_2}{J_2}. \quad (116)$$

Here J_2 stands for $\sqrt{R_2^2 + L_2^2\,\omega^2}$, the secondary impedance. (117)

The secondary impressed electromotive force may be written $M\,\omega I_1 = I_2\,\sqrt{R_2^2 + L_2^2\,\omega^2} = I_2\,J_2$. Hence

$$\frac{I_2}{I_1} = \frac{M\,\omega}{J_2} = \gamma. \quad (118)$$

Bearing this relation in mind, and substituting in (114) the values for $\overline{H\,J}$, $\overline{J\,Y}$, $\overline{O\,H}$ and $\overline{Y\,K}$, we have

$$\tan\Phi = \frac{L_1\,\omega - \left(\frac{M\,\omega}{J_2}\right)^2 L_2\,\omega}{R_1 + \left(\frac{M\,\omega}{J_2}\right)^2 R_2}. \quad (118a)$$

When the value for J_2 in (117) is substituted in (118) and multiplied out, this value for tan Φ, obtained by geometrical processes from the diagram synthetically constructed, assumes the form analytically obtained in (113). This sign is different, but this is simply because in one case the angle is considered to be the angle by which the current lags behind the E. M. F., whereas in the other case it is the angle of advance of the E. M. F., before the current. The angular relations are thus identified.

Identification of Relative Magnitudes—To show the concordance of the synthetic and analytic results in this respect, it will suffice to determine the relation between the primary current and impressed electromotive force according to the two methods. By the analytical method (65) we have the relation:

$$I_1^2 = \frac{E_1^2}{\frac{\alpha^2 + \beta^2}{\omega^4\,J_2^2}}, \quad (119)$$

where $\alpha^2 = \omega^4\,[\omega^2\,(L_1\,L_2 - \omega^2) - R_1\,R_2]^2$

and $\beta^2 = \omega^6\,(R_1\,L_2 + R_2\,L_1)^2$.

Hence

$$\alpha^2 + \beta^2 = \omega^4\,[L_1^2\,L_2^2\,\omega^4 + M^4\,\omega^4 + R_1^2\,R_2^2 - 2\,L_1\,L_2\,M^2\,\omega^4 + 2\,R_1\,R_2\,M^2\,\omega^2 + R_1^2\,L_2^2\,\omega^2 + R_2^2\,L_1^2\,\omega^2]. \quad (120)$$

$$\alpha^2 + \beta^2 = \omega^4\,J_2^2\left\{R_1^2 + 2\left(\frac{M\,\omega}{J_2}\right)^2 R_1\,R_2 + \left(\frac{M\,\omega}{J_2}\right)^4 R_2^2 + L_1^2\,\omega^2 - 2\left(\frac{M\,\omega}{J_2}\right)^2 L_1\,L_2\,\omega^2 + \left(\frac{M\,\omega}{J_2}\right)^4 L_2^2\,\omega^2\right\}. \quad (121)$$

The value in (121) may be readily shown to equal (120) by giving J_2 its value $\sqrt{R_2^2 + L_2^2\,\omega^2}$ and multiplying out

Substituting (121) in (119), and writing γ for $\frac{M\,\omega}{J_2}$, as before, we have:

$$I_1 = \frac{E_1}{\sqrt{(R_1 + \gamma^2\,R_2)^2 + (L_1\,\omega - \gamma^2\,L_2\,\omega)^2}} = \frac{E_1}{J_1'}. \quad (122)$$

This is the value of the primary current in terms of the primary impressed electromotive force, and J_1' the equivalent impedance of the primary.

Let us now return to the diagram, Fig. 25, and obtain the relation between the magnitudes of the primary current and electromotive force from the geometry of the figure. The impressed electromotive force is the *vector* or *geometrical* sum of three parts: $R_1\,I_1$ $(= \overline{O\,H} = \overline{X\,Y})$ to overcome ohmic resistance; $L_1\,\omega\,I_1$ $(= \overline{H\,J})$ to overcome the counter electromotive force of self-induction; and $M\,\omega\,I_2$ $(= \overline{O\,G} = \overline{J\,K})$ to overcome the back electromotive force due to the secondary current. $\overline{J\,K}$ may be resolved into two parts, $\overline{Y\,K}$ in the same direction as $\overline{O\,H}$ or $\overline{X\,Y}$, and $\overline{J\,Y}$ in the opposite direction to $\overline{H\,J}$, at right angles to $\overline{X\,K}$. Hence

$$E_1 = \sqrt{(\overline{X\,Y} + \overline{Y\,K})^2 + (\overline{H\,J} - \overline{J\,Y})^2} \quad (123)$$

But $\overline{Y\,K} = \gamma^2\,R_2\,I_1$ and $\overline{J\,Y} = \gamma^2\,L_2\,\omega\,I_1$, from (115) and (116). With these values, and $\overline{R_1\,I_1}$ for $\overline{X\,Y}$ and $L_1\,\omega\,I_1$ for $\overline{H\,J}$, (123) becomes

$$E_1\,I_1 = \sqrt{(R_1 + \gamma^2\,R_2)^2 + (L_1\,\omega - \gamma^2\,L_2\,\omega)^2} = J_1' \quad (124)$$

which is identical with (122). This establishes the concordance of the analytical and graphical methods in regard to the relative magnitudes of the various quantities. The angular relations have already been shown to be concordant.

Since this article was first written an interesting article by Mr. Kennelly on the "Impedance of Mutually Related Circuits" has appeared,* which accords with the results here given. Since reading his paper we have made some changes in the form in which our results are expressed, in order to make the agreement perfectly obvious. Following his example, we have adopted J for impedance; his n corresponds to our γ, and his r to $L\,\omega$, as used by us. The equation given by Mr. Kennelly on page 307 corresponds to (122) in the present article.

It is interesting to note that when the secondary resistance is zero (internal and external) $\gamma = \frac{M}{L_2} = \frac{I_2}{I_1}$. If there is no magnetic leakage, $\frac{M}{L} = \frac{S_1}{S_2}$; and the ratio between the secondary and primary currents is inversely as the ratio of the turns of wire in each coil. As the secondary resistance increases, this ratio γ becomes less than the ratio of turns. Magnetic leakage likewise causes γ to decrease.

The interpretation of (123) is that the primary electromotive force (which is usually considered as made up of three parts, $R_1\,I_1$ and $L_1\,\omega\,I_1$, 90 degrees apart, and $M\,\omega\,I_2$ obliquely inclined) may be considered as made up of four parts, consisting of two pairs of magnitudes at right angles to each other, namely $(R_1 + \gamma^2\,R_2)\,I_1$ and $(L_1\,\omega - \gamma^2\,L_2\,\omega)\,I_1$. The square root of the sum of the squares of these two pairs gives the total impressed electromotive force according to (123). The interpretation of (122), as pointed out by Mr. Kennelly, is that the primary has an equivalent impedance—the ratio of electromotive force to current—which is numerically equal to the hypotenuse of a right triangle, one of the sides of which is equal to the primary resistance plus γ^2 times the secondary resistance, the other side being equal to the primary inductance $L_1\,\omega$ minus γ^2 times the secondary inductance $L_2\,\omega$.

Analytical work is considered to be of little use by many who look with favor upon geometrical representation. Although the latter is much to be preferred in many ways, yet the value of the former must not be underestimated, inasmuch as it often enables us to establish graphic methods of wide application. The subject of condensers is for the present deferred, but their effects may be readily introduced in the transformer diagram in the same way as in the case of single circuits treated in the writers' treatise on Alternating Currents. Their effects have been analytically shown above.

Objection has been raised by some against both geometrical and analytical work, inasmuch as the results are modified in practice by hysteresis. Although this is true, still the modification is so slight that the actual performance of a transformer is practically as here described. The concordance between the predetermined theoretical effects of a condenser with a transformer and the results of actual experiments, as recently presented before the American Institute of Electrical Engineers, well illustrates this very point. The agreement between theory and practice is best shown, however, by transformer diagrams, similar to those given in this series of articles, actually obtained by experiment. These were given in a paper already referred to before the Electrical Congress, and are reprinted in *Electricity*. The diagram corresponding to the one in Fig. 25 is so similar that a glance convinces one of the remarkable agreement between the theoretical and experimental curves.

* THE ELECTRICAL WORLD, Oct. 21, 1893.

THE ELECTRICAL WORLD'S DIGEST

OF

CURRENT TECHNICAL ELECTRICAL LITERATURE

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

NOTE.—Owing presumably to irregularity in the mails, several journals were not received; they will be abstracted as soon as duplicate copies can be obtained.

ELECTRO-PHYSICS.

Interference of Electric Waves.—An article from the "Arch. des Sc. Phys. et Nat.," Vol. 20, page 358, is noticed in the Lond. "Elec. Rev.," Nov. 3. It describes the researches of Messrs. Sarasin and De la Rive, already noticed in these columns; according to Hertz long electric waves travel at a greater rate, apparently, through the air than through metallic wires, while, at the same time, the velocities in the two media are approximately the same for short waves; the researches were intended to investigate this inequality and the conclusions are summarized in the notice as follows: "The circular resonator responds to a constant wave length whatever may be the dimensions of the exciter; the intensity of the secondary spark alone varies, attaining its maximum for a given length of the exciter. One-fourth of the wave length of a circular resonator is approximately equal to twice its diameter. In the case of normal reflection from a metallic surface the first node is exactly at the mirror. The velocity of propagation of an electric wave is the same for air and for conducting wires."

Strength of the Waves When the Spark Passes in Oil.—Mr. Bauernberger in an article in the "Wein. Ber.," July 13, abstracted in the "Phil. Mag." for November, states that in Lester's arrangement, the electrical resonance is increased if the primary spark passes in oil instead of in air; petroleum gives the best results; for each distance of the electrodes a definite current strength is required to produce a maximum of electrical resonance.

Electric Radiation in Copper Filings.—An experiment before the Physical Society, by Mr. Croft, is described briefly in the Lond. "Elec.," and "Elec. Eng.," Nov. 3; a battery, galvanometer and glass tube containing copper filings were joined in series, and under ordinary circumstances no current passed; but as soon as an electric spark was produced by an electric machine many feet off, the galvanometer was violently deflected and remained so until the tube was tapped; aluminium and copper seemed about equal in their action, but iron was not so good, while carbon always allowed the current to pass; in the discussion Prof. Minchin said that the phenomena were like those of his impulsion cells which became sensitive to light the moment when a spark was passed, even at a distance of 130 feet; he said the change was due to electromagnetic vibrations, and not to the light emitted by the sparks.

Conductivity of Solutions.—In a paper from "Wied. Ann.," Vol. 60, page 261, by Mr. Holland, abstracted in the "Elek. Zeit.," Nov. 3, on the change of the electric conductivity of solutions on the addition of non-conductors, he states that when various salts are dissolved in methyl alcohol, to which non-conductors such as benzol, toluol, turpentine, etc., have been added, the conductivity decreases, but that the decrease changes with the nature of the non-conductor and the degree of saturation; the temperature coefficient increases only slightly.

Lightning Induction Discharges.—According to the Lond. "Elec.," Nov. 3, Prof. Lodge commented as follows on the curious case abstracted in the Digest, Oct. 28, in which a table was set on fire by small induction discharges in the table cloth due to lightning: "The note regarding indirect fire from lightning is interesting. It would be difficult to vouch for the occurrence in any particular instance, but I am already convinced that such resonant sparks occur and do cause fires. There is an instance in the Hotel de Ville, Brussels. Gas leaks act as the usual tinder. One would not expect a fringe to catch fire quickly enough."

Maxwell's Hypothesis.—In "La Lum. Elec.," Nov. 4, Mr. Blondin, in a mathematical article, discusses Maxwell's dynamic theory of electromagnetism, and points out that that hypothesis is not justifiable; he shows that when the bodies are in motion, conductors or non-conductors, the equations of the electromotive force given by Mr. Maxwell are not exact, also that in the case of dielectrics the signification of the differential coefficients in the equations are not sufficiently defined, and that if one accepts the electro-dynamic theory of light the results of experiments made with the velocity of propagation of light in moving mediums do not permit one to consider these coefficients as the components of the velocity of the material medium, as one does in the case of conductors.

High Frequency Discharges.—The Lond. "Elec. Rev.," Nov. 3, describes briefly the article of Mr. Swinton in the "Phil. Mag." for September, which has already been noticed in these columns.

Prof. Lodge's Hypothesis.—A correspondent to the Lond. "Elec.," Nov. 3, in reply to Prof. Poynting's remark that "we have no sense affected by the ether alone," suggests that the eye is such an organ; this is discussed in an editorial. In the same number Prof. Poynting replies to this, as also to the remarks of Prof. Lodge.

Pyro and Piezo Electricity.—The "Phil. Mag.," for November, contains a communication by Lord Kelvin "On the Theory of Pyro-Electricity and Piezo-Electricity of Crystals." It is also reprinted in French in "La Lum. Elec.," Nov. 4, and "L'Elec.," Oct. 28.

Complex Quantities in Electricity.—Mr. Steinmetz's paper, read at the recent Congress, is reprinted in the "Elek. Zeit.," Oct. 20, Nov. 3, and is to be continued.

MAGNETISM.

Compensator for Hysteresis.—In the Lond. "Elec.," Nov. 3, Mr. Vignoles discusses the subject of the effect of hysteresis in measuring instruments. In order to get rid of the error he says the instruments should always be used with the current in the direction, or if this is impossible the full current must be sent through it in the direction in which it is required to be used before any reading is taken; also that the current must be broken just before any reading is taken; if these conditions are strictly fulfilled the reading of an instrument containing iron, he says, is absolutely reliable, and it may even be used as a standard; for the least possible hysteresis error the length of the iron in the direction of the induction should be made as small as possible so as to diminish the coercive force. After mentioning the device of Mr. Abdank Abakanowicz (described in the Digest, Oct. 7), he gives a description of an ingenious device of Mr. Evershead which, in its simplest form, consists of a coil with two cores, the smaller one being made, say of hard steel, having a much greater coercive force than the larger soft iron one; when the current is cut off the hard core remains more intensely magnetized, and the return path for its induction is partly through the soft core which is thus demagnetized; by suitably proportioning the parts, the effect outside the core may be completely obliterated; the condition for perfect compensation in such apparatus as that of Mr. Abdank Abakanowicz is, that the two curves of magnetization must be similar but on different scales, but he finds that this condition is exceedingly difficult to obtain.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Standard of Light.—Mr. Blondel, in "La Lum. Elec.," Nov. 4, discusses the subject in referring to Prof. Thompson's Congress paper; he states that Captain Abney was really the first to suggest the use of a known surface of the crater of an arc as a standard of light; Mr. Blondel states that the figure given by Thompson is about 100 per cent. too low; also that he, Blondel, only proposed to use the arc as a secondary standard in connection with the Violle standard; he claims that there ought to be two standards in practice, one of a yellow tint, such as the Violle, and the other a white light such as the arc, and that the two should be compared with each other accurately once for all; if the Violle standard is not sufficiently practicable either the Carcel or the Hefner lamp could be used as a secondary standard.

DYNAMOS AND MOTORS.

Theory of Rotary Field Motors.—Mr. Boucherot's article, mentioned last week, is continued in "La Lum. Elec.," Nov. 4. According to certain authors the mutual induction of the coils resulted in a diminution of the self-induction in each, and that this reaction even reduced the self-induction to nothing, but this, he says, is not correct; the inductance, he says, is equal to the resistance for a difference of velocity of the field and the armature, which in a certain case was 200 revolutions, that is for a frequency of 3.33 periods per second, from which it follows that for a frequency of about 50 periods the ratio of the inductance to the resistance will be about 15, which is about the ratio in alternators containing iron in the armature. Regarding the use of a condenser, he shows that it is not practicable on account of very great variations in the frequency of the armature current; in a certain case, for instance, a condenser which would produce a maximum torque at starting would reduce the torque to almost nothing at high velocities; resistances may be introduced into the armature circuit, which vary with the velocity, so that the resistance is always equal to the inductance in the armature, and in this case the torque will be constant, and one could even make it slightly greater at starting than at full load, but he does not believe this has been used successfully in practice. For an industrial motor it is necessary that whatever be the velocity, an increase of the torque should correspond with a diminution of the velocity and a diminution of the torque with an increase of velocity, in which case the torque will be a maximum at starting and decrease continually as the velocity increases; he believes there is not a single rotary field motor which answers these requirements; in order to approach these conditions it is necessary to sacrifice the output per weight, and consequently the efficiency. Regarding the efficiency, he states that in such machines it can either be very good or very bad, depending on the speed of the rotating field; regarding the armature only, his theory indicates that the efficiency of the armature is equal to the ratio of the velocity to the velocity of the field; when the materials are well utilized he believes there is no reason why the efficiency should be less than that of continuous current machines.

Starting Alternating Current Motors.—"L'Elec.," Oct. 28, gives some figures regarding the currents required; a 10 h. p. motor in Geneva required for starting 250 amperes and 110 volts, or more than 37 h. p., and for quite a time; certain other motors requiring normally 80 amperes, required up to 300 at starting; others required 40 amperes for one to two minutes at the start, while only 20 amperes were required while running; in all these cases the motors were started without a load; a 2 h. p. required 28 amperes at 110 volts while running loaded and 25 amperes when the belt was thrown off; the motor which gave the best results was one having a commutator and resembling in principle an ordinary continuous current motor, it required 32 amperes when running loaded and only 35 for starting with a load; in conclusion it stated that alternating current motors without brushes, although ingenious, are not practicable when run on lighting currents.

TRANSFORMERS.

Impedance in an Air-Core Transformer.—In a recent Physical Society paper abstracted in the Lond. "Elec." and "Elec. Eng.," Nov. 3, Mr. Rimington shows that although the difference of phase between the primary voltage and the primary current is always diminished on closing the secondary circuit, yet, under certain circumstances, this closing increases the impedance of the primary; with constant voltage, this means that closing the secondary decreases the primary current, a phenomenon which, he believes, is not usually observed; the frequency is below a certain critical value; the critical conditions answering for increased impedance are fully worked out in the paper; in the case of two identical coils with no magnetic leakage the critical value of $a = \frac{pL}{r}$ (in which $p = 2\pi$ times the frequency, L the inductance of the primary and r its resistance) is $\sqrt{2}$, while that to give a maximum impedance is the reciprocal of $\sqrt{2}$; the maximum increase possible is 15.5 per cent.; the corresponding values are given in the original for various amounts of magnetic leakage. The discussion which followed was favorable, but showed that it had been observed before. Prof. Minchin showed that the impedances might be represented by two hyperbolas having p^2 as abscissas and the squares of the impedances as ordinates. Dr. Sumpter remarked that the increased impedance meant a decrease in the lag of the primary current behind the primary voltage; Mr. Blakesley showed that to get increased impedance the sum of the lag angles in primary and secondary must exceed 90 degrees; to get large power in the secondary the primary lag should be nearly 90 degrees, and the secondary about 45 degrees.

Continuous from Alternating Currents.—The illustrated description of Mr. Pollak's device (see Digest, Aug. 5 and Nov. 4), from "La Lum. Elec.," is reprinted in the Lond. "Elec.," Nov. 3.

ARC AND INCANDESCENT LIGHTS.

Lighting of Workshops.—Mr. Dobson's paper, mentioned in the Digest last week, is concluded in the Lond. "Elec.," Nov. 3. It is devoted, to a great extent, to the discussion of the insurance risks regarding the use of arc lamps in cotton mills; the insurance companies (presumably of England) absolutely refuse to allow open arc lamps to be used in cotton mills on account of the combustion of what is called cotton "fly," that is the small cotton threads which are deposited on all objects in a cotton mill; he shows that this fear is absolutely groundless and describes experiments made to prove this; the inconsistency of the insurance companies is shown by the fact that they allow the use of open gas jets in such mills; they cite two cases of fire which, however, that writer shows were due in one case to a carbon falling on loose cotton, while in the other case only incandescent lamps had been used. He describes and illustrates the Pieper arc lamp, and mentions the results which were entirely successful; regarding the cost he gives a few figures from which that of electric lighting appears to be more than that of gas, but as the light is so much more satisfactory, he thinks it may prove an economy in most cases to adopt it; from his figures it appears that the candle power was almost nine times as great, showing that per candle power the arc light is considerably cheaper.

Double Filament Lamp.—A lamp containing two filaments made in England is described and illustrated in the Lond. "Elec. Rev.," Nov. 3; the junction of the two filaments is connected to one of the lamp contacts, while the two other ends are connected to two similar metallic parts of the base, separated by a thin sheet of insulating material; when one filament is consumed, this sheet of insulating material is removed, thus bringing the two plates in contact and making connection with the second filament; in the Edison form of base with a screw thread, the lower knob is made of two plates separated by a thin piece of insulating material, which, when removed, allows the two metallic parts to come in contact.

Arc Lighting.—There has been a discussion in the recent issues of the Lond. "Elec. Rev." between Prof. Carhart, of Ann Arbor, and Mr. Carter, the latter claiming that beyond 1,000 volts it is impracticable to use close coiled armatures, while the former shows that such armatures are used successfully and in large numbers in this country, some of them being for as much as 6,000 volts.

TRANSMISSION OF POWER.

Transmission from Tivoli to Rome.—"La Lum. Elec.," Nov. 4, continues, at considerable length, its description of this installation, including a number of cuts showing details of the line and views of the station.

Transmission of Power.—Prof. Unwin's fifth lecture on "Transmission by Compressed Air" and "Distribution by Steam," is given in abstract in the Lond. "Elec. Rev.," Nov. 3. The conclusion of his third lecture and a portion of the fourth are given in the Lond. "Elec. Eng.," Nov. 3.

ELECTRIC RAILWAYS.

Cable and Electric Railways.—The Lond. "Elec. Rev.," Nov. 3, in an editorial, reviews favorably an article in the "Railway World" (London), in which various railway accounts are analyzed, giving what are said to be exceedingly useful figures as to the cost of cable and electric haulage. The editorial states that English cable roads are superior to the American and less expensive, and therefore electric traction will have more to compete against in England than in America; the Edinburgh cable line, which is one of the oldest in Great Britain, is said to be one of the most efficient in the world. The cost of the motive power per car mile is 2.2 cents, and the traffic expenses 5.32 cents, the total being a little over 12 cents per mile, as an average for the past three years; the total cost per car mile on the City & South London electric line is 32 cents, but the receipts are twice those usually obtained on cable lines; the "locomotive and generating expenses" on the latter are 12.96 cents, and on the Liverpool line 8 cents, while the passenger earnings are 49.4 and 53.2 cents; it states that although electric roads work cheaply at first, the maintenance bill increases alarmingly in subsequent years; this is attributed in a great measure to the abnormal expenses of faulty earth returns; belief is expressed that the prospect of success of accumulator lines is bright, even though the record of the Birmingham line is a dismal one; in conclusion it says that the prospects of electricity as a motive power are distinctly good, and that there is ample justification for the establishment of new lines.

Motor Gearing.—In the first part of an anonymous article in the Lond. "Elec. Eng.," Nov. 3, the subject of gearing for tramway motors is discussed; a table is given of the speeds of the car axles for different sizes of driving wheels and different car speeds, some of which are also given in the form of a diagram; a table giving the arrangements of gears and other data of electric roads in England and a few on the Continent is also given; the average reduction for double gears is nearly nine to one; for a figure of merit it is proposed to multiply the speed of the motor by its weight and divide the product by the output, the smallest figure of merit being the best; this figure is given for 14 different roads, the lowest being 453 for the "S. Staffs." (South Staffordshire?) line, that of the Thomson-Houston standard type being 570; in the former, double helical gears are used with a single reduction of four to one, and in the latter straight spur gears with a single reduction of 4.78 to 1; it states, however, that many other points besides these must be considered, not the least important being the prime cost; it concludes that the single reduction type is the most satisfactory; little is said about gearless motors, the utility of which, however, is doubted.

High Speed Railroading.—In a communication to the Lond. "Elec. Rev.," Nov. 3, Mr. Behr, the author of a recent pamphlet on "Lightning Express" (see Digest, Oct. 7, 21, and Nov. 4), answers a number of criticisms which have been made on this pamphlet. He shows that there is no doubt that the public wants more rapid means of traveling and cites the proposed roads in Belgium, the United States, Austria and France; after enumerating the objections to existing roads he shows how they can be overcome by using his single rail system; his cars can be made of any desired length, as they are made up of links which move on joints, each link accommodating 40 passengers; they are constructed to pass over curves of 150 ft. radius; each wheel has two motors attached to it; a car for 100 passengers and their baggage would have three links, 24 motors on 12 wheels capable of producing 1,600 h. p., the total weight when loaded being 60 tons, or five tons per axle; when a car meets with an accident which causes it to stop, the stoppage is instantly communicated to every other car on the line, and as they are several miles from each other, they will come to a stop without any danger of running into each other; the conductors are said to be completely isolated, and the cars are to be thoroughly ventilated by a suction of the air due to the high speed of the car; a few other details of less interest are also given.

Remscheid.—"L'Ind. Elec.," Oct. 10, gives an illustrated description containing a plan, profile and several views of this railway.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Two-Phase System.—In his serial in the Lond. "Elec. Rev.," Nov. 3, the first part of which was noticed in the Digest last week, Mr. Kennedy continues to discuss the advantages of that system. The article appears to be worth reading in full by those interested; it does not admit of being abstracted briefly. Among other things he states that every continuous current dynamo is really a multiphase dynamo in which currents are commutated; an armature with 60 coils, for instance, generates 30 currents in 30 different phases; according to his opinion, the best multiphase generator is an ordinary continuous current generator on which connections are made to obtain currents of different phases; such machines, he says, will eventually displace all others in ordinary distribution; he believes that, by commutating multiphase currents, as in the ordinary direct current machines, one deprives the currents of most valuable properties. A continuous current system could not take advantage of improvements, which he says are likely to be made in incandescent lamps, increasing their voltage to 150 or even 200, thus increasing the saving of copper in the mains; the two-phase system could readily take advantage of such a change; he claims that it is also more efficient than either the direct or the alternating current system; "a city, town or district adopting such a system is provided for against all future developments and improvements, whether in continuous or alternating current appliances, whereas, in adopting one or other of the two older systems, the march of improvement will soon leave them behind and render their plant to a considerable extent so much scrap metal." To obtain the highest efficiency from any generating plant storage must be adopted to a great extent; he intends to describe two methods for using storage batteries with such currents. He describes and illustrates a continuous current dynamo with the well known arrangement of permanent connections to different parts of the armature leading to slide rings from which multiphase currents are then taken.

Alternating Current Distribution.—The Lond. "Elec.," Nov. 3, contains another letter from Mr. Lucas on this subject; see also the Digest of last week.

Fluid Fuel.—The Lond. "Elec. Rev.," Nov. 3, calls attention to a paper read before the Technical Society of the Pacific Coast by Admiral Selwyn, in which he claims to produce astonishing results by using oil fuel, blown into the furnace by means of steam; he claims to have evaporated 48 pounds of water for each pound of oil used, or about six times that now obtained with coal, and explains it by the combustion of the nitrogen in the air; he does not seem to substantiate it, and his conclusions are doubted.

Utilization of Waste Heat.—The Lond. "Elec. Rev.," Nov. 3, describes and illustrates a new apparatus recently introduced in England.

Gablonz.—The "Elek. Zeit.," Nov. 3, contains a long descriptive article by Mr. Uppenborn, including 19 cuts, of the station in this Bohemian town; water power is used in connection with accumulators, and one of the interesting features is that during the daytime the same water power is used to drive a factory, while at night it is used for generating electricity, thus greatly reducing the cost.

Westminster.—In its serial on central stations the Lond. "Elec. Eng.," Nov. 3, describes one of the substations of the Westminster company.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Official Telegraphic Vocabulary.—According to the Lond. "Elec.," Nov. 3, the International Telegraphic Bureau at Berne is completing this work, which it is believed will be on sale toward the end of next year; it has been undertaken at the cost of the States of the union, and it is probable that the International Telegraphic Congress, which will meet at Budapest in 1896, will make its use obligatory in all the States of the union.

ELECTRO-CHEMISTRY.

Lead Dust for Accumulators.—Mr. Liebenow, in the "Elek. Zeit.," Nov. 3, gives the results of some experiments made in order to test the relative capacities of accumulator plates made with fine lead dust and in the usual manner with lead oxides; similar grids were filled with the different materials; taking the capacity for the usual lead paste as 100 per cent., that for lead dust was 43.3 per cent., for lead dust with 10 per cent. of minium 46.7 per cent., and lead dust with 10 per cent. of litharge 60 per cent.; under the microscope the particles of lead dust were quite appreciably larger than those of the oxides; they were made by blowing steam through molten lead; another test was made with finer lead dust made by grinding, and the result was 55 per cent.; in a third test extremely fine lead dust was used, the particles of which were about the same size under the microscope as the oxides, and the result was from 81 to 85 per cent.; he states that the cost of the finest minium is only 30 per cent. more than pure lead, while that of this lead dust is six times that of pure lead; in using lead dust more material can be put into the grids than in using the oxides. He believes that there is no future for lead dust accumulators.

Gadot and Pisca Accumulator.—"L'Elec.," Oct. 28, gives a brief illustrated description of this new accumulator, the plates of which are grooved with horizontal ridges; in order to avoid the connections between one cell and the next they are made in the form of twin plates; that is, two plates permanently connected at their lugs, one being a positive plate in one cell and the other a negative plate in the next; there are no supports in the retaining cells, the plates being held entirely by porcelain blocks resting on the tops of the cells; a deep space is left below the plates for the deposits which may be formed.

Epstein Accumulators.—A report made by the editors of the Lond. "Elec. Rev." on these cells is published in that journal in the issue of Nov. 3; the weights, dimensions and results of tests are given in detail; a five-cell traction battery weighs 244 pounds, and yields 90 ampere hours at a rate of 30 amperes; the efficiency in ampere hours was about 95 per cent., and in watt hours about 78 per cent., thus giving 5.6 watt hours per pound of plates, or 3.6 per pound of cell, at a rate of about .95 ampere per pound of plates.

Copper Oxide Battery.—Dr. Boettcher, in the "Elek. Zeit.," Nov. 3, mentions some recent improvements made in his cells, in which he now uses a self-sustaining plate of copper oxide, which is supported between vertical zinc plates, thus reducing the resistance materially. He claims that it is an error, which he and Messrs. Leland and Chaperone have made, to suppose that it takes three parts of the alkaline hydrate for every one part of zinc, as a six months test made by him shows that one part of the former suffices for every one part of the latter. He claims that the value of the by-products of this battery, which are soda and pure zinc oxide, will fully cover the cost of the solution and the zinc consumed, making the cost of the current equal to that of the mercury used for amalgamation; he gives tabulated data of a series of tests.

Primary Batteries in Theory and Practice.—Mr. Cooper's serial is concluded in the Lond. "Elec.," Nov. 3; he discusses very briefly batteries for electric lighting, and describes the Maquay battery.

Purification of Sewage.—According to the Lond. "Elec. Eng.," Nov. 3, experiments are being carried out at Havre with the Hermite system, in which chloride of magnesium is decomposed in the presence of chloride of sodium, which serves as the conductor, the resulting liquid being a disinfectant of great power; a central station has been constructed from which the liquid is distributed in pipes through the streets like water or gas; a careful examination of sewage thus treated shows an absence of the usual injurious bacteria.

Electrical Etching.—An article from a German journal, abstracted in the "Elek. Zeit.," Nov. 3, states that electrical etching has advantages over the usual methods, in that the solution need not be nearly as strong, and that when seen under the microscope the etched lines and edges produced by intersections are quite even and clean cut, while in the usual method they are rough, due probably to the gas bubbles formed, and the lines are apt to be rough, the metal being eaten away below them; the disadvantages are that the current requires to be regulated, and that the solution must not be allowed to be too strong. A detailed description is given of how the electrical method is used; among other things, it states that it is better to use a solution of the salt of the metal of which the plate is made, in preference to an acid bath; a good covering material is made of a mixture of equal parts of asphalt and copal varnish.

MISCELLANEOUS.

Publication of Physical Research.—The Lond. "Elec., Nov. 3, contains an editorial on this subject; discussions of the subject of the publication of physical papers have been going on for some time in "Nature," including a paper by Mr. Swinburne and another by Mr. Bassett. The same number contains also a letter from Mr. Fournier, in which, after discussing the subject, he suggests a sort of scientific news agency in the form of a central office for the distribution of physical information of a specialized class to those interested in the subject; it would collect all the physical papers appearing in the four scientific languages and send out references, abstracts or translations, made by any duplicating process, to its subscribers.

Educational.—The Lond. "Elec.," Nov. 3, reprints a short paper from the "Engineer"; also a report of the department of the City and Guilds of London Institute. The Lond. "Elec. Rev.," Nov. 3, gives a short statistical notice regarding the same institute.

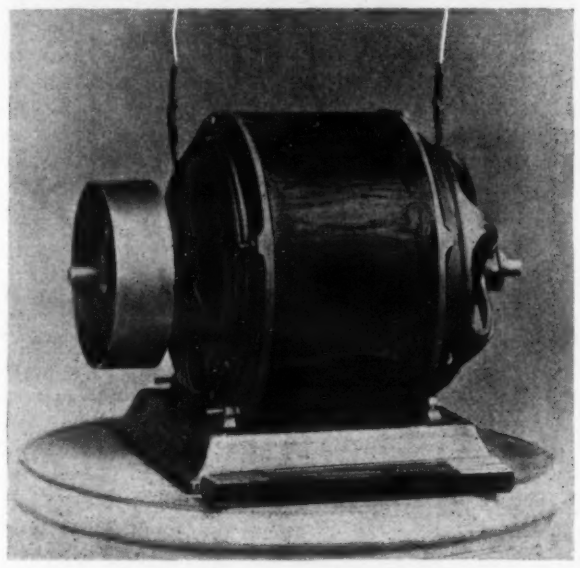
Clockwork Bells.

The mania for inventing strange things to go by springs, and "to be periodically wound up," has now spread to door bells, in the shape of a plausible imitation of the electric bell. You press a button, and a gong rings just inside the door as long as the button is pressed. For people who prefer that their visitors should hear the bell rather than their servants, this ought to be very useful.—London "Electrician."

New Alternating Current Motors.

For some time past Messrs. Elias E. Ries and Gordon J. Scott, of the Ries Electric Specialty Company, Baltimore, Md., have been devoting their attention to a type of single-phase alternating current motor that promises some very interesting results. They claim that it is not only possible to construct a self-starting non-synchronous alternating current motor of any desired power that will run economically on single-phase circuits of any commercial frequency, such, for example, as that in common use for incandescent lighting, but that such motors can be made far more efficient than the best continuous current motors. They have built a number of experimental motors of various types and sizes, embodying some of the results of their investigations, and with such success that they are now making preparations to build alternating current motors for commercial use.

An illustration is given of a motor having a capacity of one horse power, designed for and tested upon an ordinary 50-volt alternating incandescent light circuit with a frequency of 133 cycles per second. The most



A NEW ALTERNATING MOTOR.

noticeable feature is the small size and weight for a motor of its output and frequency. The total height of this motor, including base, is 9½ inches, the diameter 9 inches, and the width, exclusive of end plates containing bearings, 5 inches, and the total length of armature shaft 11½ inches, while the total weight is but 35 pounds, of which only two pounds is copper. It is claimed that actual brake measurements made upon this motor, when running at various speeds upon a 50-volt circuit of a frequency of 133, showed that at a speed of 2,000 revolutions per minute and taking 15 amperes of current the motor developed .80 h. p. at an electrical efficiency of 90 per cent., the motor remaining perfectly cool after a continuous run of eight hours. With 10 amperes of current, .54 h. p. was developed, with an electrical efficiency of 93 per cent. On increasing the load, thus reducing the speed to about 1,000 revolutions for the same flow of current, the power developed was substantially the same as before and with very nearly the same efficiency. When the speed was reduced below 600, the efficiency dropped off appreciably, although not enough even in the case of this light machine to detract from its usefulness for effective work at speeds much below those now practicable in direct current systems.

With a five-inch driving pulley the torque developed by the motor was so great that it started off promptly under full load. Its speed is shown by tests to be variable within wide limits and without appreciable loss in efficiency. Another novel characteristic of this type of motors is the claim that with a given flow of current torque increases up to a certain point as the speed decreases. Perhaps the most remarkable claim for the machine is the fact that the losses and other difficulties that have heretofore attended the use of comparatively high frequencies for alternating current motor work, whether single-phase or multiphase, have been practically eliminated, a move in the opposite direction to the present tendency toward low frequency.

This type of motor is particularly applicable for station and railway work where widely fluctuating loads are encountered, and it is claimed that it is quite impossible to burn it out or injure it by excessive overload, as it will not receive any more than its maximum normal current under any conditions.

In addition to the experimental motor illustrated herewith, Messrs. Ries and Scott have built other single-phase motors of larger sizes that are now doing successful work in their factory. Some of these motors are designed as synchronous working, and run at constant speed under varying loads. They are self-starting and run rapidly up to synchronism without the use of a special coil or switch, and will automatically regain synchronism should their speed be temporarily reduced below it by means of a heavy overload. The inventors state that they can predetermine the characteristics of machines with as much accuracy as in the case of direct current machines. They are rapidly completing designs for a full line of these motors, ranging all the way from ⅛ h. p. alternating current fan motors to the largest sizes that may be required for stationary work, and have in course of construction a single-phase high frequency alternating current railway motor of 40 h. p. capacity, for which they claim one-half the usual weight and also the embodiment of some novel features which will have an important bearing upon electric railway work.

Canadian Mica.

Within a few years the mica industry of Canada has begun to assume an important character. Up to 1890 the yearly production amounted in value to less than $30,000, the output being almost entirely used for stoves and furnace doors. During the latter year, however, Canadian mica began to be used for electrical insulating purposes, and during 1892 the exports alone amounted to more than $70.000.

On account of the superior cleavage of Canadian mica it is greatly favored by electricians, and is largely used by electrical manufacturers in the United States. The Schenectady Electrical Works is one of the largest consumers, the bulk of the mica used by them coming from Canada. Their requirements, which are amply met by Canadian mica, are that it shall be smooth, free from wrinkles and crevices, must split readily and must be flexible, so much so that a piece of mica .010 inch thick would bend to a curvature of about three inches diameter without cracking. Mica that has dark spots or spots similar to rainbow color, or what is known as smoky mica, is not at all suitable for electrical purposes. Mica must also stand a flame of intense heat without crumbling up or showing any disintegration. The principal sizes of mica used by them are: Commutator mica, 1½ by 4 inches, 1¼ by 6⅝, 1⅝ by 4¼, 1⅜ by 6½, 1⅜ by 8, 1¾ by 8, 2 by 5, 2½ by 5, 2 by 7, 2 by 12, 2½ by 12, 4 by 4, 5 by 8; binding mica, 1¼ inches wide.

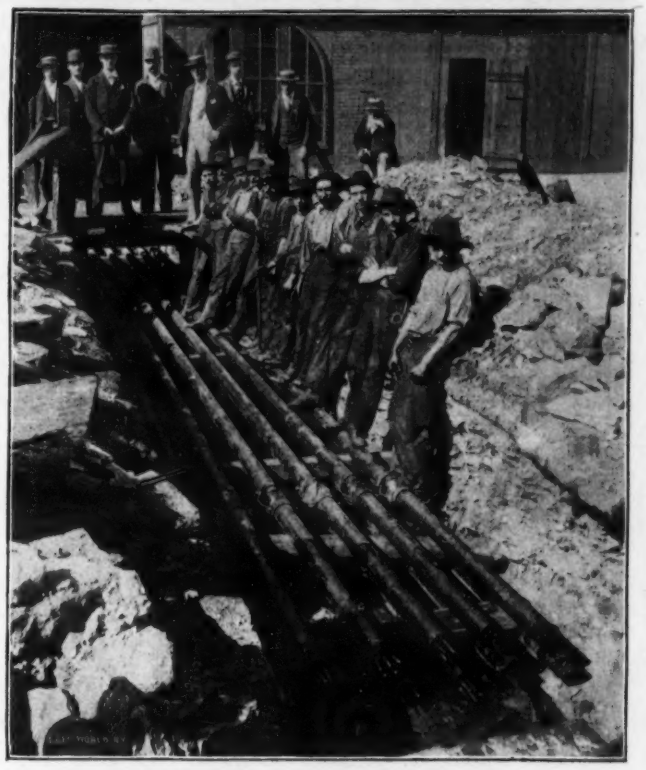
In mining the mica great care is taken to avoid drilling through the mica crystals or breaking them unduly. The mica thrown down by blasting undergoes a preliminary hand dressing underground. It is then taken to the "mica shop," where it is split with knives into sheets of the required thinness and afterward sheared into sizes. The workman has on his bench a stationary pair of shears and a large number of blocks or templates of the sizes to be cut. An experienced mica cutter can tell at a glance the largest size which can be cut from a given piece of split mica. He selects the proper template, holds it on the mica and shears the four sides, using each edge of the block as a straight edge. Each size sheared is set away by itself. At the factory of the Lake Girard mica mining system in Ottawa this hand labor is greatly reduced and a great saving effected by the use of patented cutting machines operated by electricity. The production of merchantable sheets is usually from four to five per cent. of the block mica brought from the mine, and may run as high as 8 or 10 per cent.

The Lake Girard mines referred to form together one of the largest producers of mica in the world. Of the dozen or more mines worked by the company, the most valuable one is at Wakefield, Ottawa county, Quebec, in regard to which a mining engineer has reported that the deposit is the most extensive yet discovered in the Laurentian system, and the richest so far known on the American continent. The average daily output of this mine is now close to five tons. The mine is equipped with excellent accommodation for a large working force, with the various buildings necessary for the operations, consisting of engine and shaft houses, blacksmith's and carpenter's shops, cobbling-sheds, stables, office and dwelling-houses, all of which are supplied with the electric light. The working plant comprises two boilers of 38 and 54 h. p. respectively, and two of 55 h. p. each; one seven and one three inch drill, an Ingersoll compressor and equipment; one double cylinder hoisting engine (Copeland & Bacon), and one double hoist, 18 inches by 30 inches; Worthington and other pumps (three in number); Kay dynamo for 100 Edison lamps; derricks, etc. The mica as it comes from the pit is weighed and delivered to the dressing shed, where it is separated in different sizes; it is then carried by a car automatically handled on an inclined track to the foot of the hill where the loads are taken up by wagons and transported to the cutting and dressing works at Ottawa. In this commodious structure there are at present in use 23 power presses for cutting irregular shaped discs and segments. These power presses are all of American manufacture; 20 of them are from the E. W. Bliss Company, Ltd., of Brooklyn, N. Y., two of them from the Ferracute Machine Company, of Bridgeton, N. J., and the other manufactured by the Long & Allstatter Co., of Hamilton, O. Eighteen of the Bliss machines are the well known bench presses and specially suitable for cutting patterns most in demand at the present time. The dies used in this factory are the most complete at present employed for this purpose, and include some 16 different patterns ranging in size from 5¼ by 10 inches to ⅞ by 3 inches, and with a few exceptions are all made in Ottawa. During the past year there have been on an average 70 men and women employed in this factory.

The Cummings Conduit at St. Paul.

We give herewith a view of a section of the Cummings conduit, recently installed in the Edison central station system at St. Paul by the Cummings & Engelman Conduit Company. This section of conduit conveys all the current from the dynamos to the pole from which radiates the feeder lines of the entire system.

As will be noticed, there are 12 tubes in all, in each of which there are five 000 copper wires. This conduit when tested showed 400 megohms before current was turned on.



THE CUMMINGS CONDUIT.

The Cummings & Engelman company has a contract with the St. Paul company for many other circuits in addition to the one illustrated.

It is interesting in this connection to note that many thousand feet of this valuable conduit is now in actual service, some of it having been in successful use for more than two years. Fourteen hundred feet have recently been laid for the Co-operative Electric Light Company, of Chicago, in which the Siemens-Halske system is used, and a contract has recently been closed with the Niagara Power Company for the exclusive use of this conduit to convey the large amount of energy that is to be transmitted from the Falls to neighboring cities.

One special advantage in the Cummings conduit is that it makes possible a transfer from existing overhead circuits to underground without additional cost of copper. All that is necessary is to place the tubes in position, draw the bare copper wires through the tube, and turn on the current.

An Electrical Naval Outfit.

The Brazilian cruiser Nictheroy has been fitted with as complete an electrical equipment as any on the new United States cruisers. The contract for the work was let on Nov. 2 to the General Electric Company, with the condition that the entire equipment should be installed and in thorough working order by Nov. 12. On the evening of that day, just eleven days after the signature of the contract, the switches were closed and everything pronounced in perfect working order. This is a record, in view of the difficult and special character of marine electrical work, and the extreme care that must be taken to avoid accidents and errors.

The plant consists of two 10 by 10 50 h. p. Ideal engines, each belted to a standard General Electric compound wound bipolar dynamo of 30 kilowatts (40 h. p.), or 540 16-c. p. lamps capacity each. Upon an incombustible slate switchboard near the dynamos are mounted a full complement of marine volt and ammeters, and a double pole knife switch for each circuit leaving the board. There are five circuits for the 300 incandescent lamps installed, two for the search lights and one for the 50-h. p. motor. The switchboard is so arranged that each dynamo can be used either on the motor or lighting circuits.

The wires from the board are led through a special molding, and wherever exposed to moisture are provided with a leaden armor. All the appliances, such as switches, receptacles, etc., are of the same watertight pattern as used on the United States war vessels, as are also the fixtures, portable lights, deck and battle lanterns. For the last named, a separate circuit has been provided. They can thus be carried from place to place, and connected at different convenient points.

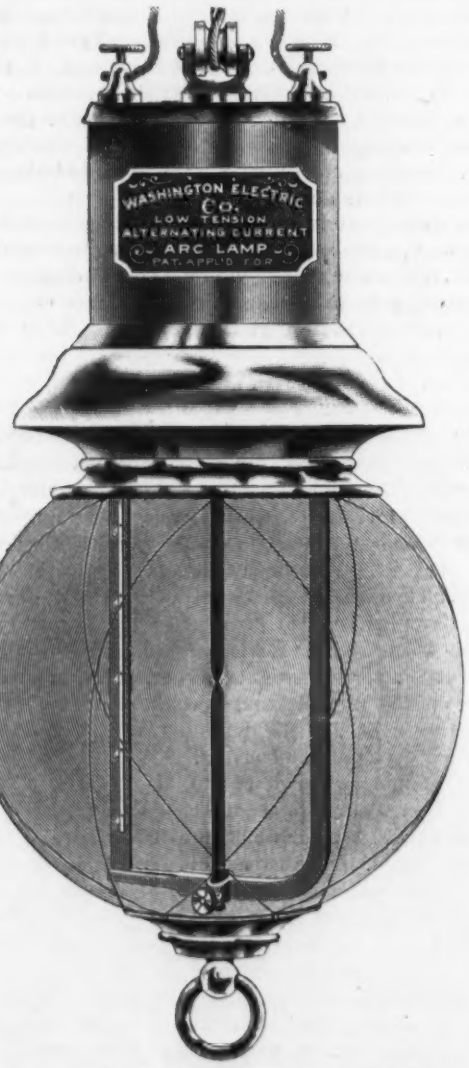
On the roof of the pilot house is set the automatic

30-inch search light, similar in size and intensity to that on Mt. Washington, which throws a beam of light which it is claimed can be seen from Portland, Me., 85 miles away. That on the Nictheroy is flanked on both sides by Hotchkiss rapid firing machine guns, and it can project a beam of light from its spherical concave mirror sufficiently powerful to allow light colored objects to be easily distinguished at 6,000 yards. It is furnished with a diverging door made of strips of glass, by which the beam can be diverged horizontally to cover a wide space, and permit of the discovery of an object moving in the field of light. The diverging door is then moved back, and the full light of the beam concentrated upon the object, rendering it an easy mark for the guns. The lamp takes a current of 100 amperes to produce an effective arc between the points of the two 1¼-inch carbons. In the pilot house is a small switchboard. From this the search light is electrically controlled, and may be moved in any direction horizontally or vertically. The small motors which do this work are concealed in the iron pedestal of the projector. The after search light is used as an auxiliary. It is of the same pattern, but has a mirror of only 12 inches, and is hand controlled. The 50-h. p. motor is used to train the dynamite gun, which can be raised, lowered, or turned to left or right, as required. A system of electric signals completes the electrical outfit.

The Britannia, the other vessel which is to take part in the expedition, will be fitted with one 24-inch and one 12-inch projector.

The Washington Arc Lamp.

In the history of mechanical and electrical development, the most conspicuous productions are those noted for their simplicity. The greatest inventions of all time are those characterized by an entire absence of complicated parts or intricate mechanism. A new arc lamp recently placed on the market by the Washington Electric Company, 197 Canal street, Chicago, under the name of "The Washington," has this character of simplicity, and compared with other arc lamps now in use the little amount of mechanism is surprising, the few parts employed being almost crude in their ingenious simplicity. A good view of this lamp is given in the illustration. The total length is but a few inches greater than the carbons, making it the shortest lamp on the market, it is claimed, for the length of carbons used. A lamp designed to burn 12 hours, with two nine-inch carbons, measures over all but a fraction more than 20 inches. For all classes of work where a compact form is desirable, this lamp has therefore a particular value.



THE WASHINGTON ALTERNATING CURRENT ARC LAMP.

The carbon feed is regulated in a simple manner. The large single coil shown is in series with the arc, and is the only thing about the lamp that can be designated regulation mechanism. To the armature of this magnet is attached an adjustable lever pivoted on the lamp frame. The current flowing through the magnetic coil operates this lever, this in turn operating the traveling feed as follows: The traveler (acting at the same time as the upper carbon holder) consists of two carefully adjusted cog wheels incased in a brass covering. With no current flowing through the coil, this traveler will fall gradually. Instantly the arc is formed, the armature of the coil is pulled down, by which action it draws up a slide rod that extends the entire length of the opposite lamp frame, throwing the traveling feed out of gear and holding it at rest until a variation in current causes the rod to release the feed and thereby maintain the proper distance of the arc.

The lamp is especially designed for alternating circuits, and is wound to burn at 30 volts, secondary, or with 52 volts by using a Meissner automatic retardation coil which reduces the current. It is guaranteed to give 1,500 c. p. with 10 amperes, and 2,000 c. p. with 15 amperes, and burns 8 or 12 hours, according to the length of carbon.

The lamp is very short for the length of carbon used, and therefore presents a handsome appearance with its oval shaped globe, which is protected by wire network. When used on alternating circuits there is practically no noise, and little or no trouble in trimming. Owing to the small amount of mechanism the lamp is little liable to get out of order.

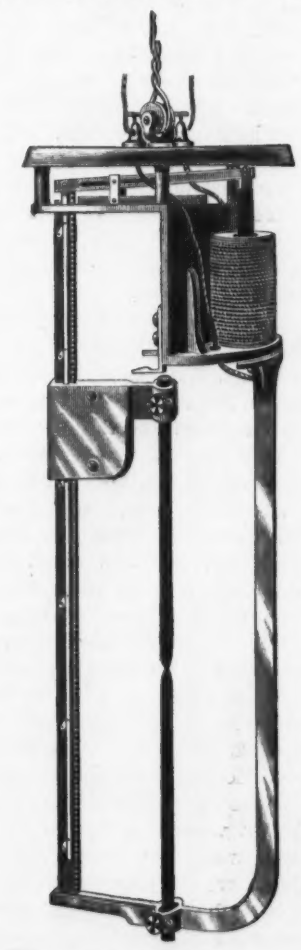
An Improved Gasoline Torch.

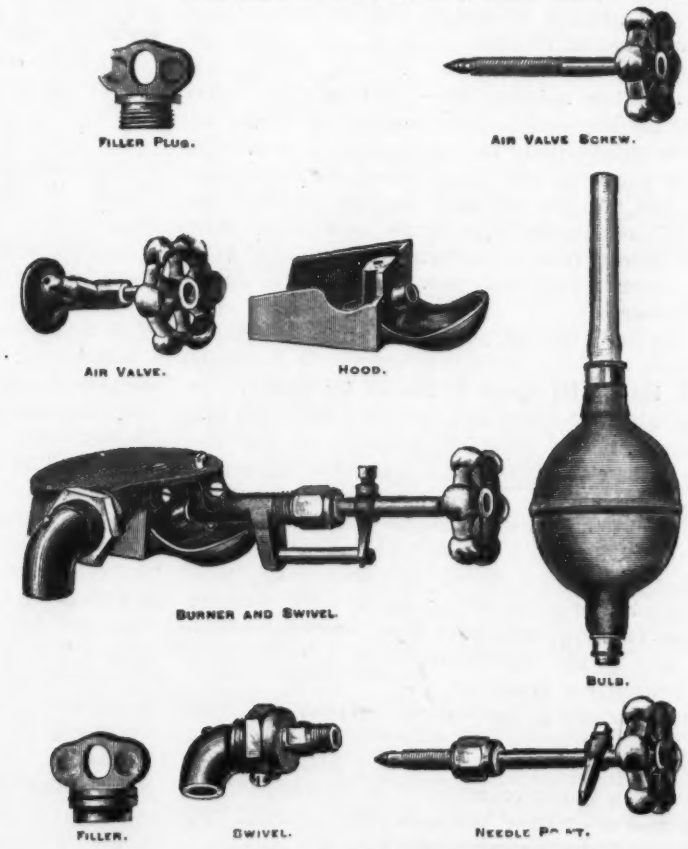
The Clayton & Lambert Manufacturing Company, of Ypsilanti, Mich., have recently made improvements in the burner of their No. 1 furnace and torch, which give it additional advantages. Referring to the accompanying illustration, there is shown a quick-acting thread on the needle point, by means of which one turn opens the burner full, while the projecting guide prevents the needle from being forced too far in at closing. At the point where the needle enters the burner shank, there is a stuffing-box, thus entirely doing away with leakage there, even though the needle fits very loosely. Another advantage is that the needle instead of tapering to a point comes to a shoulder and then to a blunt point, thus furnishing a double shut-off. All these improvements together make a burner that never leaks, has a cool handle, and is so easily regulated that even a careless workman cannot put it out of order.

An Automatic Fire Alarm Apparatus.

An exhibition was given on Saturday of last week at 59 Liberty street, New York, of a new automatic fire alarm system by Mr. Willard J. Day, president of the Automatic Fire Alarm Company, Baltimore, Md. The system consists of a combination of any number of thermostats in connection with a district telegraph service.

The thermostat consists of a rubber strip, which, upon application of heat, becomes warped and makes a contact which completes an electric circuit. An ordinary district telegraph call-box is fitted with an attachment by means of which, when any one thermostat is completed, the call mechanism is released and records in the district telegraph office the number of the building. The box serves for the usual messenger calls, the fire calls being distinguished from the fact that a number of records are made in rapid succession at the main office instead of only one, or several at irregular and longer intervals, when a messenger is called. Mr. Day claims a fundamental patent on all warping thermostats consisting of a single material, but finds that rubber of the quality used by him is the best for the purpose.



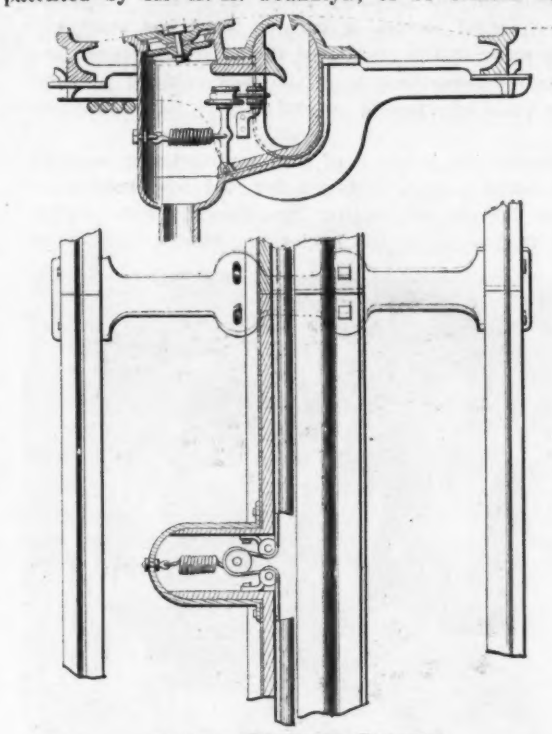


DETAILS OF IMPROVED GASOLINE TORCH.

It will be seen that this furnishes a simple method of automatically transmitting a fire alarm to a central station. It can be installed in any house by merely substituting a new call-box and wiring in parallel with it any number of thermostats desired, no special apparatus being required in the district telegraph office, or any additional line wire.

A New Electric Railway Conduit.

We illustrate a new electric railway conduit recently patented by Mr. H. H. Franklyn, of 24 Clinton street, Brooklyn. The inventor claims that his system is very simple and easy of construction; the conduit has good drainage and the wire is thoroughly insulated and kept perfectly dry by the shield shown. It is also claimed that all wires can be taken out without interfering with the road bed. The hatched lining is of an insulating material which can be molded or formed in the shell before the latter is put in place, or previously made in lengths and sections and then inserted into place. The other features of the conduit are made plain by the cut.



A New Electric Conduit.

NEW BOOKS.

Standard Tables for Electric Wiremen. With Instructions for Wiremen and Linemen, Underwriters' Rules, and Useful Formulas and Data. By Charles M. Davis. Fourth edition, thoroughly revised and edited by W. D. Weaver. Flexible morocco. 128 pages. Price $1.

The third edition of this popular work was exhausted within a few months after its issue, and the fourth edition has been delayed in order that it might contain the latest revisions of the Insurance Rules of the Underwriters' International Electric Association, now almost exclusively used in the United States, and which will probably soon entirely supersede all others. In addition to the above rules there has been added to this edition an important section on the calculation of alternating current wiring which, for the first time, brings this subject within the reach of practical men. Although the

effect of impedance in alternating circuits is of great importance, the matter has only heretofore been treated in the pages of a few learned publications and then, with the exception of Kennelly's recent Institute paper, in a manner beyond the reach of all without a knowledge of the higher branches of mathematics, and with an entire absence of practical deductions. The method given here of calculating the increase of drop is thoroughly practical and easily followed, requiring no knowledge of mathematics beyond simple arithmetic.

A number of the most important tables were prepared expressly for this work, and, being copyrighted, cannot be found elsewhere. Among these are the tables of alternating current wiring coefficients, those on limiting currents for exterior wiring and on the candle power of arc lamps, and one enabling the tables for the three standard lamp voltages to be used for any voltage or drop, as well as several others, including a complete set of wiring tables calculated on a uniform basis of 55-watt lamps.

The method of determining the sizes of conductors for incandescent wiring enables feeders, mains and branches to be proportioned as nearly exact as desired, instead of only approximately as by other methods. The wiring formulas for motor circuits, etc., are put in the most simple and practical form so as to be easily applied by any one. The formulas for horse power of engines and boilers are published here for the first time, and while they are based on rational principles, the different values of heating surfaces in boilers being considered, the results they give are the actual commercial ratings and not the theoretical horse power.

ELECTRICITY AT THE PARIS EXPOSITION OF 1889. By Carl Hering. New York: The W. J. Johnston Co., Ltd., 41 Park Row. Cloth, 250 large octavo pages, 62 illustrations. Price $2.00.

In order to meet the wishes of those to whom the cumbersome government collection of official reports of the various United States Commissioners to the Paris Exposition will not be available, the complete portion relating to electricity has, with the consent of the author, been republished in convenient form for reading and reference. The work contains a general description of the more important exhibits, accompanied by comparisons, opinions, statistics and in general such information as would indicate the state of the art, and includes an account of the work of the International Congress of Electricians. While attention is paid to all classes of exhibits those relating to primary and secondary batteries and to measuring instruments are particularly full and accompanied by numerous illustrations. The sections on telegraphy and telephony will also be found interesting for comparison with American practice. The volume in its various parts contains information and descriptions of apparatus that will be found of value to all those interested in electricity, and as a work of reference the book will be of particular utility.

LITERARY NOTE.

THE PHYSICAL REVIEW (Cornell), for November-December, contains the following articles relating to electricity: On the Electric Strength of the Solid, Liquid and Gaseous Dielectrics, by Prof. Alexander Macfarlane and G. W. Pierce; General Discussion of the Current Flow in Two Mutually Related Circuits.—II., by Drs. Bedell and Crehore; Some Rapid Changes of Potential, Studied by Means of a Curve-Writing Voltmeter, by Prof. Moler; Irregularities of Alternating Current Curves, by Dr. Bedell and Messrs. Miller and Wagner. There is also an account of the work of the recent International Electrical Congress, and an extended review of the Transactions of the Frankfort Electrical Congress.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Nov. 18, 1893.

ONE ELECTRICAL STOCK or another, furnished this week, at times almost the whole stock market. There has, of late, been a disposition to relegate electrical securities, once conspicuous by their activity, to the background, but this week they have again come forward in a way to show that they have lost none of their pristine glory as speculative favorites. Generally speaking, nothing important enough to actually affect the intrinsic value of the securities of electrical companies has occurred this week in the trade; business matters are still in a reconstructive period, and until a more definite impetus is given to trade matters there will continue to be lacking that basis for calculation so essential to the movement in either direction of stock quotations.

GENERAL ELECTRIC, in a market that was practically featureless, barring the exception, furnished the sole sensation of the week in stock exchange circles on Thursday; it practically monopolized Wall street's attention. Out of total transactions of about 180,000 shares, an amount, by the way, often exceeded in a single hour in active periods, 31,250 shares, or over one-sixth of the shares traded in, were those of the General Electric Company. The net result of these comparatively large transactions was a loss of five points. Since Thursday some of the loss has been repaired, so that to-day's closing quotation, 39½, shows a loss for the week of but 2⅝ points. Accompanying such fluctuations there has actually been a tremendous amount of talk, much of it wild, most of it useless, a little founded on actualities. The endeavors to explain Thursday's drop from 43 to 38 were in many instances as ingenuous as they were farfetched. The general impression now is that the sudden attack on the stock was the outcome of a well concerted bear plan, the object of which was to make covering purchases along the entire list as soon as it had been sympathetically affected by the bear raid on General Electric. That the plan carried well Thursday's quotations bear ample witness to. The receivership story naturally played first fiddle in the tune the bears played. It was openly stated on the floor of the Exchange that the officers had consulted their legal advisers concerning some important legal step, and this was construed as indicating the nearness of the receivership. It is pretty certain that the prospects of an early resumption of dividends are rather slim just now, but otherwise there is nothing in the company's financial affairs, so say officials, to warrant adverse legal action. In December $250,000 must be disbursed as interest on the debenture bonds, but this money, according to an official statement, is already in the bank. In January a dividend on the preferred stock is due, but the company's management professes its entire ability to meet this obligation. One report credited with having a deal of influence in bringing about the decline was to the effect that an expert examination recently made into the company's books had brought to light facts of such adverse character that a large foreign interest, acting on this information, had determined to close out its holdings, and that this explained the heavy and persistent selling. Everything isn't exactly lovely in the company's future. Although it is authoritatively denied that Mr. D. O. Mills, one of the largest stockholders and one of the biggest subscribers to the syndicate underwriting the funding of the floating debt, has resigned from the Board of Directors, it is positively asserted on the other hand that Mr. Mills is conspicuously identified with the organization of a powerful opposition. Then it is declared that the company lost a large amount of money on the Intramural Elevated Road at the World's Fair, and that its want of ready capital had compelled it to forego bidding for very profitable contracts. A specific instance mentioned was that of the Brooklyn Traction Company, but the officers of the General Electric Company declare that 400 motors had already been delivered to the Brooklyn company, and that cash had been paid for them. As giving the company's side of the state of affairs, it might be well to give the statement published this week in a Wall street paper by a leading director of the company. "General Electric affairs have been put in such shape that the company is no longer losing any money. It may not be making much, but it is not losing anything. It has no floating debt. The company has closed all of its works which are not absolutely necessary to the profitable operation of the plant. The company has never had as excellent management as it is having to-day. Some of the directors have taken upon themselves the responsibility of the company's personal supervision of the management. It is hardly likely that dividends will be resumed until there is an improvement in the general business situation. The business which the company is doing is only such as yields a cash profit or such profit in securities as will not hamper the free use of necessary capital under its control."

WESTERN UNION TELEGRAPH STOCK is marked for lower prices. This assertion is confidently made on all sides, and, to judge from their published remarks, insiders are seemingly not adverse to a decline. Thus one director says that "the falling off in gross earnings is greater than usual, since the close of the Fair. The reconstruction work of the company, which has been carried on so largely for the past two years, has been completely stopped." Another insider says: "The decrease in earnings has been sufficient to make insiders hesitate about increasing their lines at present." The natural result of such talk has been to create quite a bearish feeling on the stock, and this has led to many adverse remarks. It is freely hinted that the March dividend will be reduced. People supposed to know state, however, that dividends are in no danger, and that the year ending next June will show $1,000,000 or more net earnings above dividend requirement. This is calculation of a rather far-reaching nature.

THE WESTINGHOUSE ELECTRIC COMPANY'S officials were obliged this week to again deny the report that they contemplated a consolidation with the General Electric Company. President George Westinghouse was very emphatic in his assertion that such an idea had never been harbored by him; said he: "I would not take the General Electric Company as a gift."

THE ELECTRIC TRACTION COMPANY'S stocks in Philadelphia have, this week, had a sudden and material advance on the news that it was about to join the People's Traction Company of the same city and form a consolidation whereby over 150 miles of street car roads were to be concentrated in the hands of one corporation, all to be run by trolley motors. No confirmation of the story has as yet been obtainable.

THE MUTUAL ELECTRIC LIGHT AND POWER COMPANY, of Chicago, which was run through the City Council last week, to destroy the monopoly of the Edison Electric Light Company, of Chicago, proves to be a boodle measure merely, and its threatened competition amounts to nothing. Consequently, Edison stock has recovered a deal of the loss brought about on the first announcement of a rival.

THE BROOKLYN EDISON ELECTRIC ILLUMINATING COMPANY'S stock will probably be benefited indirectly by the recent political revolution in that city. Under the old regime, the rival electric company of the Edison people had an undue influence with the city government. But with a change in the municipal affairs, the chances are that the Edison company will now have equal rights and do more business. This has led to inquiries for the stock among Wall street brokers. The stock is now quoted at 90 bid, 95 asked.

ELECTRICAL STOCKS, NOV. 20, 1893.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " " com	15	15	17½
Edison Electric Ill., New York	100	97	98
" " " lsts	...	104	105
Edison Electric Ill., Brooklyn	100	90	95
" " " Boston	100	115	124
" " " Chicago	100	220	230
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	..	2⅛	5
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	4	5
General Electric Company	100	45¼	45⅛
" " deb. 5's	..	79½	80
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	24½	25
" pfd	50	40	42
Cleveland General Electric Co	..	85	90
Western Union Telegraph	..	87¼	..

AFFAIRS OF THE COMPANIES.

MR. S. NORRIS CRAVEN, Philadelphia, Pa., formerly with Mr. E. A. Blanton, lessee of the Howard Foundry and Machine Company, has formed a company known as the E. Norris Craven & Company, Limited, for the manufacture of electric and hydraulic elevators, and has leased the entire building, 515 Mulberry street. Experienced hands, new and modern machinery, and substantial orders are good omens for the undoubted success of this company.

THE MARYLAND ELECTRIC COMPANY, Baltimore, has issued bonds for $1,000,000, and has been authorized to issue $1,000,000 in stock. The money will be used in the erection and equipment of a large plant for the supply of electricity for all the purposes for which it is used, including the lighting and heating of private dwellings and other buildings. The company now operates the Fort Wayne plant, in Baltimore, under the management of J. Frank Morrison. The capital above mentioned has nearly all been subscribed by outside capitalists.

THE ANSONIA ELECTRIC COMPANY.—On Nov. 11 C. S. Mersick, of New Haven, was appointed receiver of the Ansonia Electric Company, to succeed J. B. Wallace, who resigned the position in view of the steps taken by the creditors of the concern to remove him. The retiring receiver was examined by the counsel for the creditors in regard to his report, which was submitted to the Court. In the examination Mr. Wallace said he owned about $150,000 worth of stock in the company, and drew a salary of $4,800 a year. He also admitted that he was in debt to the firm on an overdraft to the amount of $30,000. The inventory shows that the liabilities were a little over $100,000, and the assets about $271,000. In regard to the talked of compromise, Mr. Wallace said that the only party that stood in the way was the Ansonia National Bank. The compromise was on the basis of 10 per cent. in cash and 50 per cent. in notes. Receiver Mersick was placed under $40,000 bonds.

THE AMERICAN CARBON COMPANY is the title of a corporation recently organized to manufacture and supply carbons for all kinds of work. Its capital stock is $500,000. The works of the company are at Noblesville, Ind., while its main offices are at Dayton, O. The company is particularly fortunate in owning a large tract of natural gas territory, and has an unlimited supply of the very best carbon fuel. Recent tests have shown that the carbons obtained from this section are superior to other makes for purity of light and length of life. The daily capacity of the works is 150,000 carbons, the works being, it is asserted, the best equipped of their kind in the world. They cover an area of more than five acres, and each department is in charge of a thoroughly experienced and competent man. With such men as J. H. Vail, president; W. W. Smith, treasurer; Edmund Dickey, secretary, and Philo Moses, manager, there is every indication that the company will meet with unusual success.

NEW INCORPORATIONS.

THE PENN TRACTION COMPANY, capital stock $10,000, has been formed to operate passenger railways by cables, electrical appliances, etc. I. M. Thomas, G. W. Shonk and J. B. Yeager are the promoters.

METROPOLITAN ELECTRIC COMPANY, Chicago, Ill., capital stock $300,000, has been formed to manufacture and deal in electrical apparatus and supplies, etc. The promoters are E. S. Elliott, J. E. Campbell and H. A. Ritter.

THE SIMPSON ELECTRICAL SUPPLY COMPANY, Chicago, Ill., capital stock $12,000, has been formed to manufacture and deal in electrical and other supplies. G. D. Coleman, H. R. Pebbles and Thomas Fahey are interested parties.

MANAYUNK PASSENGER RAILWAY COMPANY, Philadelphia, Pa., capital stock $12,000, has been formed to erect and operate an electric railway in that city. Fletcher Pearson, James Rawle and J. T. Dunlap are the promoters.

THE ANTHRACITE ELECTRIC RAILWAY COMPANY, Pottsville, Pa., capital stock $500,000, has been formed to construct and operate an electric railway in Pennsylvania. J. Newlin, E. S. Newell and L. B. Walker are the promoters.

THE COMMERCIAL ELECTRIC ENGINEERING COMPANY, Detroit, Mich., capital stock $50,000, has been formed to do general electrical engineering and contracting business. The organizers are J. B. Moore, G. E. Fisher and O. D. Chase, all of Detroit.

THE AMERICAN STETHOPHONE COMPANY, Chicago, Ill., capital stock $5,000,000, has been formed to manufacture stethophones, lines, exchanges, etc., and to deal in electrical instruments and appliances. The promoters are R. D. Wade, J. B. Phelps and W. Olds.

THE REED ELECTRIC COMPANY, Camden, N. J., capital stock $500,000, has been formed to manufacture and sell storage batteries and other electrical apparatus and devices. G. Stahl, Philadelphia, Pa.; J. Reed and W. A. Robbins, Camden, N. J., are the promoters.

THE BAKER ELECTRIC LAMP COMPANY, Portland, Me., capital stock $400,000, has been formed to manufacture and deal in arc and incandescent lamps, etc. F. A. Whiting, Lowell; C. A. Stellman, Newton, and B. C. Mudge, Lynn, Mass., are interested in this venture.

THE PITTSBURGH & HOMESTEAD ELECTRIC STREET RAILWAY COMPANY, Pittsburgh, Pa., capital stock $12,000, has been formed to construct and operate an electric railway from Pittsburgh to Homestead. The promoters are H. H. Swaney, J. P. Wilson and E. G. Weinscheuk.

THE SAN FRANCISCO BONET ELECTRIC TOWER COMPANY, Chicago, Ill., capital stock $150,000, has been formed to build and operate an electric tower on the grounds of the California Midwinter International Exposition. Leo Bonet, Marie Dubois and W. H. Munnich are interested.

THE MARBLE CITY ELECTRIC COMPANY, Rutland, Vt., capital stock $50,000, has been formed for manufacturing and dealing in electricity for light and power purposes. J. A. Sheldon, F. M. Butler, H. M. Bates, Jas. Caruthers, Rutland, Vt.; H. B. Thayer, New York, and J. M. Jackson, Chicago, Ill., are interested.

THE BALTIMORE ELECTRIC COMPANY, Baltimore, Md., capital stock $10,000, has been formed to manufacture and sell all manner of electrical machinery, goods, apparatus, etc., and to supply electricity for light, heat and power, etc., etc. R. C. Rhodes, P. H. Alexander, C. C. Rhodes, C. C. West and F. V. Rhodes are interested.

THE COLEBROOK ELECTRIC LIGHT COMPANY, 209 Washington street, Boston, Mass., capital stock $12,000, has been formed to furnish electric light, heat and power to the inhabitants of Colebrook and vicinity. H. F. Holland, C. E. Eldridge, both of Boston, and W. E. Drew, of Colebrook, N. H., are the promoters.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Nov. 20, 1893.

MR. D. C. SPRUANCE, manager of the Helios Electric Company, Philadelphia, manufacturers of the Helios arc lamp, has returned from a most successful Western trip.

MR. HENRY G. ISSERTEL, 39 Cortlandt street, New York, has just returned from a trip throughout the West and Southwest. Mr. Issertel reports business on the increase through the territory over which he has traveled.

MR. K. H. HALL, 40 Cortlandt street, New York City, has succeeded John S. Hall, formerly at the same number, and will continue the business of engineer and machinist. Their specialty, Hall's oil purifier and refilter, recently placed upon the market, is meeting with flattering success.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Nov. 18, 1893.

C. S. MERSICK, of New Haven, Conn., has been appointed receiver of the Ansonia Electric Company to succeed J. E. Wallace.

THE CAMPBELL ELECTRICAL SUPPLY COMPANY, of Boston, Mass., has closed a contract with the Westboro Electric Light and Power Company for one 1,000-light La Roche machine.

THE CONSOLIDATED ELECTRIC MANUFACTURING COMPANY has closed a contract with the Deering Electric Light Company to supply the apparatus for lighting the city, including boilers, engines, etc.

THE CITY ELECTRIC COMPANY, Waterbury, Conn., capitalized at $200,000, has been absorbed by the Waterbury Traction Company. The stockholders will receive par value for the stock in five per cent. interest paying bonds, and the Traction company will also pay a premium of 50 per cent. on $100,000. The Traction company proposes to increase its capital to $600,000.

PLYMOUTH, MASS.—A corporation has been formed in Plymouth for the manufacture of the well known "Edes battery zincs," under the name of the Edes Manufacturing Company. These zincs have been made for several years by Mr. Edwin L. Edes, who is now president of the new company. A new two-story building has been erected with branch track connecting with the O. C. R. R. The new company report business as quite good, nothwithstanding the general depression. They now have good facilities for prompt shipment to New York, Boston, Providence, etc.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 MONADNOCK BUILDING, CHICAGO, Nov. 18, 1893.

THE METROPOLITAN ELECTRICAL COMPANY, Chicago, is introducing the "Anti-Thunderbolt" oil paper for armatures and other electrical work.

MR. WALTER C. M'KINLOCK, secretary of the Metropolitan Electric Company, has been confined to his house for some time on account of illness, but is again at work.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that the new Mogul Packard lamp has evidently found a large field of usefulness, if the inquiries and orders received for it are any indication of what may be expected in the future. The high efficiency of the lamp, 2½ watts, is the great feature.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has just received a boatload of electric light carbons, consisting of ½ by 12 and 7-16 by 12, and ⅓ by 7 and 7-16 by 7, both plain and plated. This will enable them to fill their orders without any delay, and handling them in such large quantities enables them to make factory prices.

THE GREAT WESTERN MANUFACTURING COMPANY, of Chicago, has received from the Chicago Fire Underwriters' Association a most flattering recommendation for the "Clark" wire, of which it is the general Western agent. Among other things, the letter says: "You will notice that this wire is named in the list of approved wires issued by this association."

THE CHICAGO INSULATED WIRE COMPANY has secured the services of Mr. Samuel D. Cushing, a graduated mechanical and electrical engineer of Lehigh University, Bethlehem, Pa., who has also taken a thorough course in the expert department of the General Electric Company, at Schenectady, N. Y. Mr. Cushing will have charge of the electrical department of the company.

PORTLAND, Ore., Nov. 11, 1893.

TIMES ARE HARD in Anacortes, Wash., where a man stole the trolley wire of a defunct railroad, and was recently caught in the act of attempting to melt down the wire to transform it into a salable shape.

THE SUNSET TELEGRAPH AND TELEPHONE COMPANY'S Seattle Exchange was recently damaged by a blaze in the switchboard, caused by a live electric light wire falling across the telephone cables. Ten cables and 500 'phones were burned out or damaged by the current and the resulting fire.

THE PORTLAND (ORE.) CORONER'S JURY placed the weight of the responsibility for the fatal drawbridge accident, in that city, upon Motorman Terry, of the East Side Railway Company. The gate was less than 30 feet distant from the draw, and the cars were not required to come to a stop at any point on the bridge.

THE WASHINGTON STREET CAR BARN AND REPAIR SHOP of the Portland Consolidated Street Railway Company was recently burned at night, and a number of cars temporarily disabled. A force of repairmen was at once set to work, and most of the cars were repaired sufficiently to go out on the road again. The cause of the fire is unknown.

CANADIAN NOTES.

OTTAWA, Nov. 18.

MONCTON, N. B.—It has been decided to instruct the City Council to purchase the electric light and gas works.

KINGSTON, ONT.—The Electric Street Railway Company here has started a Sunday service and is meeting with considerable opposition.

LONDON, ONT.—Negotiations are going on between the City Council and the street railway company with a view to converting the road into an electric system.

ST. JOHN, N. B.—The affairs of the Consolidated Electric Company are badly mixed up, and it is understood that a writ has been issued for the foreclosure of a mortgage given to the Imperial Trust Company to secure the bondholders.

ST. STEPHEN, N. B.—The presence in town for some days last week of Mr. Gerald, the gentleman who has undertaken to build an electric railway in Calais, has renewed the interest in the question of a connection with the Calais road for St. Stephen and Milltown.

MONTREAL.—The Montreal Street Railway Company has decided to have all its cars vestibuled as a means of protection to the motormen and conductors. The company has also called for tenders for the supplying of nets designed to prevent loss of life. The cars will all be fitted with them within a few weeks.

MONTREAL.—The Standard Light and Power Company has sold the Montreal Street Railway Company the remainder of their charter for $50,000, which gives the street railway company a 30 years' exclusive street railway franchise for St. Henri and St. Cunegonde. The company, by the purchase of this charter, has now exclusive rights west of Montreal to Lachine, east to Longue Point and north to the city limits.

MONTREAL.—The annual report of the Montreal Electric Street Railway Company for the year ending Sept. 30, 1893, shows for the past year's business (after paying to the city the percentage of four per cent., amounting to $28,365.96, and the fixed charges of the company) a profit of $116,032.86, as against $93,886.21 the year previous.

News of the Week.

ELECTRIC LIGHT AND POWER.

PALMYRA, N. Y., is soon to be lighted by electricity.

HYATTSVILLE, MD., is discussing the electric light.

HOWARD CITY, MICH., talks of electric street lighting.

PROPHETSTOWN, O., is agitating the question of electric lights.

WILLIAMSBURG, PA., is considering the question of electric lights.

GENESEO, N. Y., wants the electric light. Gilmour & Son are interested.

MERIDEN, MISS., has purchased the local electric lighting plant for $14,500.

PINE MEADOW, CONN.—D. B. Smith & Son will soon put in an electric light plant.

FARGO, CASS COUNTY, N. DAK., is to have an electric light plant for its courthouse and jail.

DANVILLE AND RICHMOND, IND., and Coal City and Lanark, Ill., are discussing the electric light.

GROSSDALE AND HOLLYWOOD, ILL., have united, and it is proposed to soon put in an electric light plant.

MILWAUKEE, WIS.—The South Milwaukee Electric Light Company will extend its plant in the near future.

EAST HARTFORD, CONN.—A special meeting of voters will be called to see what shall be done for eletric street lighting.

DRAVOSBURG, ALLEGHENY CO., PA.—A paper is being circulated in the interests of electric street lighting for Dravosburg.

ALTON, ILL.—The village board of North Alton has voted to have electric lights there, to be furnished by the new electric light company.

MASCOUTAH, ILL.—The stockholders of the Mascoutah Electric Light Company will issue $5,000 in bonds to pay for a proposed power house.

NATCHEZ, MISS.—Sealed proposals will be received to Dec. 7 for lighting the streets for a period of five years. T. R. Quartermann is city clerk.

OTTUMWA, IA.—The city will vote on the question of granting a franchise to the Caughlin Electric Light Company to erect an electric light and power plant.

SPRING VALLEY, ILL.—A movement is being pushed in the matter of enlarging the electric light plant, and residents are organizing with a view to purchasing and improving it.

STATESVILLE, N. C.—The committee on electric lights, of Statesville, has recommended the purchase of a new machine for the electric light station, and the board of aldermen has authorized it.

WARWICK, N. Y.—The village trustees have decided to accept the proposition of the National Light and Construction Company to light the streets for five years. The village has an option on the plant at expiration of franchise.

BRIDGETON, N. J.—The City Council of Bridgeton is contemplating the advisability of purchasing an electric light plant and building a city hall, which would necessitate the issue of bonds to the amount of at least $100,000.

THE SALEM (OHIO) ELECTRIC LIGHT AND POWER COMPANY has just closed a contract with the city to put up and operate for 10 years 100 1,200 c. p. arc lights to displace the old system of 325 incandescent lamps of 25 c. p., to be in operation by Feb. 1, 1894.

GREAT BARRINGTON, MASS.—Ward Lewis has secured for the Great Barrington Electric Company a lease of the water power at the Glendale Mills, and in a short time it is expected that an electric station supplying light and power to all South Berkshire will be in full operation.

WYOMING, LUZERNE CO., PA.—The Borough Council of Wyoming has received an offer to build and operate an electric light plant from Messrs. Patterson & Wilson, of Scranton, Pa., and the matter has been referred to a committee composed of A. J. Crouse, Fisher Gay and J. A. Shoemaker.

ST. CHARLES, MO.—Schrantz & Middlecamp, of Warrenton, Mo., have asked the Council for a 25-year franchise to operate an incandescent and arc light electric plant in the city of St. Charles. The St. Charles Light and Fuel Company also want the privilege of stretching wires, but do not ask for a definite franchise.

BANGOR, ME.—A representative of the Public Works Company has made an examination of the county jail with a view to submitting to county commissioners an estimate of the cost of electric lighting. A hearing will be given to the Public Works Company on Nov. 23 in the matter of their petition for right to erect poles and maintain wires on certain streets.

THE ELECTRIC RAILWAY.

GENEVA, N. Y.—The Geneva & Waterloo Electric Railway is again being discussed.

MAYVILLE, N. Y.—Residents are asking capitalists to build an electric road to the lake shore at Westfield.

CHESTER, N. H.—Books are now open for subscription to the stock of the proposed Chester & Derry Railroad Company.

CATASAUQUA, PA.—The Lehigh Valley Traction Company has applied for right of way through the streets of Catasauqua.

PITTSBURGH, PA.—The ordinance granting right of way to the Pittsburgh & Mansfield Railway was defeated by 22 to 20.

NEWINGTON, CONN.—The citizens of Newington are discussing the advisability of constructing a line from Newington to Hartford, connecting with New Britain.

JACKSONVILLE, FLA.—Capt. Walter S. French has been granted permission to operate a Hotchkiss bicycle railway on Main street between Orange and First streets.

ALEXANDRIA, VA.—The City Council has passed the ordinance granting right of way to the Mount Vernon Electric Railway Company through King and Cameron streets.

MANCHESTER, N. H.—President Thomas Sanders, of the Haverhill Board of Trade, addressed a meeting in the interests of the proposed electric road between these two cities.

BOSTON, MASS.—The Boston and Winthrop Street Railway is before the Council at Boston with a petition for right of way in East Boston for their road to Winthrop.

MEDIA, PA.—The Union Railway Company has commenced work on the extension to be built to its road from its terminus, the Court House, to Media railroad station.

BOSTON, MASS.—The first move in the matter of rapid transit for Boston has been made in the petition of Reynolds T. White and associates for authority to build, equip and maintain an elevated road in Boston and suburbs.

WHITEFISH BAY, WIS.—Fred. G. Isenring, T. W. Williams and Max Zabel have incorporated a company with $1,000,000 capital to build an electric road to Milwaukee, Wis. The projectors are all residents of Whitefish Bay, Wis.

LIBERTY, N. Y.—The New York, Ontario & Western Railroad will, according to the Hancock "Herald," build an electric road to White Lake. Their office is 16 Exchange Place, New York. Work will not be begun until spring.

SPRING CITY, PA.—Spring City Council has given a franchise for an electric street railway to the Schuylkill Valley Illuminating Company to run from Valley Forge through Phoenixville to Spring City, work to be begun in the spring.

DULUTH, MINN.—Col. A. A. Harris, of Duluth, is back of a movement to build an electric street railway to connect Duluth, West Duluth and West Superior. A franchise has been secured from the West Duluth Council. Capital, $800,000.

WILMINGTON, DEL.—Samuel K. Smith, of the Wilmington Steamboat Company, has bought the Gordon Heights Club property for $15,000, and it is the intention of the company to fit up a summer resort, to include hotel and electric railway from Wilmington.

EAST ORANGE, N. J.—A committee of five has been appointed to present a revised ordinance covering the petition of the Suburban Traction Company for right to operate a road here by electricity. They are Hamilton Wallis, Philemon Woodruff, J. E. Reynolds, Richard Coyne and Geo. R. Howe.

LEWISTON, ME.—It will be some weeks before a decision is arrived at as to whether the proposed road from Lewiston Junction to Poland Springs is to be an electric or a steam road. Hiram Ricker, of Lewiston, is prime mover. The road will be 3½ miles in length and work has been commenced.

TUNKHANNOCK, PA.—The Chester "News" is authority for the statement that the scheme to build an electric road from Tunkhannock to connect with the Delaware, Lackawanna & Western at Factoryville has been revived. It is proposed to locate the power house midway, either at Lake Carey or Lake Winok.

FALLS CHURCH, FAIRFAX CO., VA.—An electric railroad is proposed from Washington to Falls Church, passing through the centre of Alexandria County by way of Ballston. A meeting has been called to take definite steps. S. J. Block, of Washington, D. C.; L. S. Gordon, of Falls Church, and Jas E. Clemens, of Alexandria County, are the leaders in the movement.

PATERSON, N. J.—The Paterson, Passaic & Rutherford Electric Railway, $800,000, has been formed, being a consolidation of five companies now in the field in this section, including the Paterson & Little Falls Consolidated, the Paterson & Passaic and the Passaic, Rutherford & Carlstadt companies. Chas. A. Johnson, of Brooklyn, is president. A. A. Van Voorhies and Alfred H. Post, of Paterson, are interested. Gen. Louis Fitzgerald, representing the Mercantile Trust Company, of New York, is on the board. Work on the road from Jersey City to Rutherford will be begun.

MISCELLANEOUS NOTES.

THE UNITED LABOR LEAGUE has declared in favor of Federal control of telegraphs.

THE CALIFORNIA MIDWINTER FAIR.—The contract for the electrical display has been awarded to the Western Electric Company, according to a newspaper report.

PROF. MASCART, in the current number of the "Bulletin de la Societe Internationale des Electriciens," has a valuable paper on multiphase motors, in which the principles concerned are logically developed from elementary theory and expressed in easy mathematical language. The treatment is very complete.

THE FRIENDS OF LEHIGH UNIVERSITY will be glad to hear that the new $200,000 laboratory is now entirely completed. The electrical installation work was under the supervision of C. J. Miller, electrical engineer, of Philadelphia. This institution undoubtedly will, in the near future, take a high stand in the line of work, as its equipment is very complete in every particular.

THE NATIONAL BROTHERHOOD OF ELECTRICAL WORKERS OF AMERICA held its third annual convention in Cleveland, O., Nov. 13-17. The order was organized in St. Louis, Nov. 28, 1891, and is now represented in 65 cities, with a membership of 10,000. The convention will last four days. President Henry Miller, of St. Louis, in the course of his annual report, said that in his belief every accidental death of an electrical worker during the past year had been caused by carelessness either on the part of the man himself or his company. Much could be done by good and careful work to make the occupation of an electrical worker safer.

AN AMERICAN ACCUMULATOR SYSTEM IN GERMANY.—The Accumulatoren Fabrik, Hagen, Westphalia, has acquired

the manufacturing rights, from the Waddell-Entz Company, of the Waddell-Entz accumulator system, and which they will introduce into Germany for traction purposes. The Accumulatoren Fabrik is a consolidation of the chief storage battery interests in Germany and well qualified to take up this work. This decision was reached only after the most exhaustive experiments with the Waddell-Entz system, both in that country and in the United States. The Waddell-Entz Company is to be congratulated on the fact that its system nas been placed in such good hands, and no doubt it will rapidly make a place for itself abroad.

NO SALVAGE FROM THE WORLD'S FAIR.—Owing to clauses in contracts, of which the public and some of the higher authorities of the World's Fair were ignorant, contractors are claiming and carrying off much of the material that was supposed to be the property of the Exposition company, including the roofs and very streets. A Chicago dispatch says, referring to the electrical equipment: "Of the entire electric lighting plant, with its battery of dynamos, 8,000 arc lamps, and nearly 150,000 incandescent burners, nothing is left but the iron lamp posts for arc lights. Even the network of wires belongs to the electric companies that put them in. Most of the arc lamps have already been taken down. The smaller globes for incandescent lights are being pulled from their fastenings and packed by thousands in barrels for shipment back to the factory." There should be no surprise in regard to the electrical equipment, as there was never any reason to suppose that it was not the property of the contractors.

ANOTHER PENNOCK?—Dr. Franz Fullmer, of Chicago, claims to have produced a primary battery by means of which electricity can be obtained cheaper than with the dynamo. He says that zinc filaments three sixty-fourths of an inch thick in constant use in cells in the laboratory for two months, furnishing power for 15 lights, were found at the end of that time to be still one sixty-fourth of an inch thick, and some even more. According to the Chicago "Tribune," from which we obtain our information, the doctor says he has burned a 4,000 and a 2,000 candle power arc light, and 15 16-candle power incandescent lamps from 40 cells 6 by 8 inches four to five hours a night for six weeks without refilling the cells. He once had a cell short-circuited for 48 hours, and found at the end of that time it had lost only 1½ amperes. The components of the compound used he keeps a secret. In the cells is a thin zinc cylinder nearly encircling a small hollow core of a porous, milky appearance. The cell is filled with a dark fluid.

Trade and Industrial Notes.

THE WHALEN ELECTRIC COMPANY, Sycamore, Ill., has commenced the erection of an electrical supply factory and brass foundry. The Citizens' Association furnished a free site.

CLIFFORD BROTHERS, Hudson, N. Y., have received a contract from the Suburban Electric Company for the installation of counter-shafting, friction-clutch pulleys and cut-off couplings, etc., for their plant at Elizabeth, N. J.

MR. J. GRANT HIGH, 123 North High street, Philadelphia, is exceedingly busy, working his factory to its utmost capacity in order to keep abreast of orders. Mr. High has recently enlarged his works by adding one floor to better facilitate the completion of orders for switches.

THE LA ROCHE ELECTRICAL WORKS, Philadelphia, secured the contract for the complete installation of the electrical plant for the new State Asylum at Wernersville, Pa. The contract includes the installation of three 50-kilowatt dynamos, three engines and the complete wiring of the institution.

R. SCHEFBAUER & CO., Morrisey Building, Paterson, N. J., constructing electrical engineers, have several important contracts in hand, and have just finished a 1,200-light, a 600-light and a 400-light plant, all of the wiring being on porcelain. It is evident that Mr. Schefbauer's experience with the Oerlikon and Siemens-Halske companies, in Europe, and the Edison company, in America, is appreciated.

THE W. D. GRAVES ELECTRICAL AND MACHINE WORKS, of Cleveland, O., successor to the Graves Electrical Manufacturing Company, is congratulating itself over the fact that its arc lamp received high honors at the World's Fair from the Jury of Awards. The company is now in good shape to take care of any orders that may be received for this lamp, which is already well known to central station managers throughout the country.

THE MIAMISBURG (OHIO) ELECTRIC COMPANY reports that the telephone companies appreciate the merits of the Burnley cartridge battery, whose advantage over all others is that it is made of paper specially prepared for the purpose, and therefore cannot become cracked or broken by sudden jars, as in shipment. It is only half the bulk and only one-third the weight of any other known cell of equal power, which is also a very important feature in shipment.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has received from the Southern Pacific Railroad Company the contract for a new cotton shed at New Orleans, 120 feet wide and 350 feet long. The building will be entirely of iron, the sides being made with the Wilson patent rolling shutters. The new car barn for the Easton Traction Company at Easton, Pa., will also be built by the Berlin Iron Bridge Company. It will be entirely of iron, 64 feet in width and 200 feet in length.

THE CROCKER-WHEELER ELECTRIC COMPANY, 39-41 Cortlandt street, New York, has issued an unusually handsome catalogue, devoted to descriptions and matter relating to their well known electrical machinery. Much of the matter has a technical value, aside from the type of machine considered, and will prove useful to both engineers and students. Several new types of machines are described and a portion of the book is devoted to the application of motors to machine tools, and to motor dynamos, as well as to other special work.

THE PHILLIPS INSULATING WIRE COMPANY, 39-41 Cortlandt street, New York, reports that its "New Ideal" wire has been passed by the New York Board of Fire Underwriters. It claims that the insulation is superior to rubber insulation in many respects, as it will stand a very high insulation test; has long life; will not be injured by atmospheric influences nor oxidize the copper wire. Mr. A. A. Knudson, one of the patentees of the wire, is now identified with the company in placing the wire on the market.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Drexel Building, has just issued an illustrated 28-page circular, setting forth in a most concise manner the special points of merit of accumulators manufactured by it. Judging from the testimonials contained in the circular, both from home and foreign electrical authorities, the accumulators manufactured by the Electric Storage Battery Company have far exceeded the sanguine expectations of both manufacturer and users.

THE GREAT WESTERN MANUFACTURING COMPANY, Chicago, reports among recent sales the following: An isolated plant of 500 lights capacity in the works of the Arcade File Company, Anderson, Ind., using the Bain direct current ventilated armature dynamo; an isolated plant for the Rosenheimer Malt and Grain Company, Kenaskum, Wis., same apparatus; an isolated plant at Mannitte, Wis., same system; central station at Ladd, Ill., 1,000 lights capacity, the Bain system to be used throughout. Both alternating and arc systems will be installed at this place, all construction and supply work being handled by the company.

THE AMERICAN ELECTRIC COMPANY, of Boston, are finding the demand for their "New Era" electric gas lighters greatly enlarging, and to enable them to properly supply this increasing demand they have leased spacious premises at 102 Pearl street, supplied ample machinery of the latest improvement, and have designed and made a complete outfit of special tools for producing these burners. The inventor has made a number of valuable changes and improvements which cannot fail of prompt recognition and appreciation. The "New Era" burners, it will be remembered, are operated only by the key, which always indicates whether the gas is turned on or off.

THE HUBLEY MANUFACTURING COMPANY, Lancaster, Pa., has received a large order for electrical and mechanical apparatus from a leading New York house, to be used as a window exhibit during the holidays. The window display that will be made by this house will cost about $6,000, and toys and apparatus have been gathered from all parts of the world. The Hubley company's electrical and mechanical railway outfits, made especially for it, as well as their system of electric colored lights, will be prominent features of the exhibit. Orders have been received from a number of other New York and Philadelphia houses by the Hubley company for Christmas window displays.

FREDERICK A. SCHEFFLER, 74 Cortlandt street, New York, general sales agent of the Stirling company, has recently sold the Providence Union Railroad four 250-h. p. boilers for immediate delivery, the order having been received only after severe competition. Mr. Scheffler states that their position, taken early in the year, to break down the apparent combination of water tube boiler manufacturers, to keep them from exhibiting at the World's Fair, has been fully substantiated by their having received the highest award covering all claims originally made, especially that of handling bad feed water, and that the constant and uninterrupted service night and day rendered by their 2,800-h. p. boilers, in use at the Fair from May 1 to Nov. 1, won the unqualified approval of all members of the Executive Board.

TAYLOR, GOODHUE & AMES, Chicago, have resigned the agency of the Wagner motors and transformers, and are placing on the market a full line of motors, dynamos and transformers manufactured by the Diamond Electric Manufacturing Company, and for which the firm of Taylor, Goodhue & Ames is the sole selling agent. The Diamond transformer has always been a favorite with central station men, and the improvements made during the past 12 months place it well in the front rank and merit the consideration of all buyers of electrical apparatus. The Diamond motors and dynamos are of the latest type, combining slow speed with handsome appearance, high efficiency and good wearing qualities. They have long passed the experimental stage and are in successful operation to-day in various parts of the country. Diamond machines of 15 h. p. and larger are of the four-pole type, smaller sizes are two-pole.

THE CHESLEY ELECTRIC COMPANY, 601 to 605 Newark street, Hoboken, N. J., has just moved into its new factory at the above address, which is the only one of the kind in the immediate vicinity of New York. The ground floor, 60 feet by 70 feet, is fitted up with overhead tracks and hoisting apparatus, for the repairing of the heaviest kind of armatures and other electrical work; a special drying oven, capable of holding a 10-foot armature, is one of the features. By the use of Thomson's galvanometer and bridge, any defects in work are readily ascertained, so that when they are shipped from the factory they are ready for immediate use. They have a 500-volt power current for testing and power purposes, as well as 1,000-volt alternating current for lighting, etc. The company also buy and sell second-hand machinery, and are conveniently located near the principal railroads, as well as the East River.

J. HOLT GATES, Western manager of the Waddell-Entz company, 1139 Monadnock Block, Chicago, reports the sale of a 1,200-light direct connected generator for the Hartford Safety Deposit Building. This will be connected to a Cooper engine, at 275 revolutions. Also a 1,200-light direct connected machine to Messrs. Willoughby, Hill & Co., which will be connected to an Erie Ball engine; also a 100-h. p. railway generator, connected to an Ideal engine, to the South Chicago Street Railway Company; also two 600-light, direct connected, with Ball & Wood engines, to the Minnesota School for Feeble-Minded, at Faribault, Minn. The installation of the three large direct connected machines of the West Chicago Street Railway Company has been commenced, and they will probably be in operation in 30 days, when inspection of the public is invited. In addition to the above, during the past week, orders for three 80-kw. direct connected machines have been received, besides three 30-kw. machines, direct connected. The Waddell-Entz company builds direct connected dynamos from 15 kw., at 350 revolutions, up to 1,000 kw., at 70 revolutions. From 200 kw. up the dynamos will be connected to Corliss type engines, the armatures taking the place of the flywheel altogether. Mr. Gates further reports large inquiry for the Waddell-Entz copper and steel storage battery.

THE ABENDROTH & ROOT MANUFACTURING COMPANY, 28 Cliff street, New York, write to us in regard to the note in these columns last week, in which the Babcock & Wilcox Company give their reasons for not entering the World's Fair boiler competition. They state that the explanation does grave injustice to the judges, who are men of acknowledged standing in the engineering world, and who asked for the written statements of the exhibitors of boilers as to their claims, not to make their awards on these alone, but merely as data for comparison with their own wide experience and the extensive information collected by the engineering corps of the Fair bearing on the subject. It is asked: "If a public record was wanted based on the actual performance of their boilers at the World's Fair, why did they not accept the invitation of the Exposition officers and participate in a series of boiler tests which would have been conducted with the utmost care and fairness by such able men as composed the jury? If they were so sure of the superiority of their boiler as claimed in this letter, why did they not go on with these tests and challenge all other companies there to compete with them? If they had done this they would most positively have met with a quick response. There was never a better opportunity to prove their boast, and probably it will not occur soon again. On the contrary, when this proposition was made they were, I believe, the very first to 'withdraw their boilers from all competition,' including such tests."

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N.Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED NOV. 14, 1893.

(IN CHARGE OF W. A. ROSENBAUM, 177 TIMES BLDG., N.Y.)

11,386. (Reissue.) MULTIPLE SWITCHBOARD; M. G. Kellogg, Chicago, Ill. Application filed Dec. 3, 1890. The combination with two metallic circuit lines, of a test circuit which forms a connection with the ground, and with one side of which the lines are connected, the other side of the test circuit being adapted to be brought into connection with either of the lines.

11,387. (Reissue.) MULTIPLE SWITCHBOARD; M. G. Kellogg, Chicago, Ill. Application filed Nov. 14, 1893. The combination with a multiple switchboard of a test connection at each board, and circuit connections whereby the lines are connected with one side of the test connection for each board when the lines are switched for conversation.

11,388. (Reissue.) MULTIPLE SWITCHBOARD; M. G. Kellogg, Chicago, Ill. Application filed Jan. 23, 1893. In a telephone exchange system, a metallic circuit line normally connected with the ground at the central office, and disconnected from the ground while switched for conversation, in combination with a test receiving instrument grounded on one side, a switch testing plug adapted to be brought into connection with the line, and a battery in circuit with the instrument between the ground and the switch testing plug.

508,422. CURRENT TRANSFORMER; W. H. Hornberger, Elkhart, Ind. Application filed Dec. 17, 1892. Comprising an envelope and core of magnetizable material in thin rectangular sheets packed together; that is, with alternate layers breaking joints.

508,482. ELECTRIC LAMP FOR BICYCLES; George Mayr, Brooklyn, N. Y. Application filed March 27, 1893. The combination with a bicycle wheel having a spur wheel mounted upon the hub, a dynamo-electric machine suspended from the hub of the wheel by means of arms, the dynamo-electric machine having a horizontal shaft carrying suitable armature and commutator parts, and a pinion, the latter being adapted to mesh with the spur wheel.

508,489. DEVICE FOR INDICATING SYNCHRONISM; C. F. Scott, Pittsburgh, Pa. Application filed Sept. 28, 1892. A source of alternating currents, and a commutator adapted to cause frequent reversals, in combination with primary and secondary armatures, a coil connected to the commutator in magnetizing relation to the primary armature, and a secondary coil adapted to be inductively affected by changes in the magnetism in the primary armature. (See illustration.)

508,493. METHOD OF REGULATING SELF-EXCITING ALTERNATE CURRENT ELECTRIC GENERATORS; W. Stanley, Jr., Great Barrington, Mass. Application filed Oct. 18, 1888. The method of maintaining a constant potential at the terminals of an alternate current generator, which consists in exciting the field magnets of the generator by a current derived solely from a circuit in shunt with the work circuit and causing the work circuit to act inductively upon the shunt circuit to vary its counter electromotive force in inverse ratio to the quantity of current in the work circuit.

508,518. ELECTRIC DOOR OPENER; H. T. Johnson, New York. Application filed May 19, 1893. The combination of a movable latch block, mechanism for locking and unlocking it, an electromagnet for actuating the mechanism to unlock the latch block, and a permanent magnet for holding the mechanism out of its locking position until released by the movement of the door.

508,538. ELECTRIC RAILWAY TROLLEY; James Chase, Rochester, N. Y. Application filed April 8, 1893. This device consists of a divided trolley arm, a removable trolley wheel having a rigid shaft, oil chambers carried by the trolley arm, tapering thimble bearings seated in the inner and outer walls of the oil chambers and having oil holes in their inner sides, and an absorbent material placed in the base of each oil chamber and in the oil holes of the thimble bearings.

508,539. ELECTRIC RAILWAY TROLLEY; S. D. Field, Stockbridge, Mass. Application filed March 2, 1891. For use on electric railways, a magnetically adhesive trolley, having a magnetized wheel, provided with tread or contact faces, which are separated by a space laterally conforming to the cross-section of a portion of the stationary or line conductor, with which the trolley is to operate in rolling contact.

508,551. BATTERY ELEMENT; W. Mills, Elizabeth, N. J. Application filed Oct. 18, 1892. The combination of a carbon cup having an apertured head, a cover of larger diameter than the carbon, and detachable therefrom, and means for uniting the carbon cup and cover.

508,559. ELECTRIC LIGHTING SYSTEM; T. A. Willard, Norwalk, O. Application filed Aug. 29, 1893. In a current regulating device, the combination of a switch segment, composed of alternate direct and dummy plates, resistance coils connecting each direct plate with the adjoining dummy, a switch lever, adapted to pass over the segment, and means for giving the lever an initial slow movement, combined with a terminal quick movement at the juncture of the plates.

508,563. COMBINED MESSENGER CALL AND TELEPHONE; G. E. Christie, Paterson, N. J. Application filed Feb. 24, 1893. This comprises a call box, telephone receiver and switch ring, placed in the main circuit between call box and receiver, with transmitter and its induction coil placed in the primary circuit of the telephone battery and with the secondary circuit of the induction coil, connected through one binding post with one pole of the receiver and through another binding post with the contact plate of the switch, and with a spring controlled arm adapted to receive the switch ring, all the parts being so arranged that when the switch ring rests on the switch arm the telephone receiver and transmitter are cut out of the main circuit, and when the switch ring is released from the arm the receiver and transmitter are brought in the main circuit.

508,578. CONDUIT FOR ELECTRIC RAILWAYS; A. J. Robertson, New York. Application filed Jan. 6, 1891. A conduit or receptacle for a naked electric wire having an inner surface of insulating material whereby the water that may collect therein will be electrically insulated from the earth.

508,587. WIRE CONNECTOR; G. A. Trumble, Bellevue, Ky. Application filed July 18, 1893. A connector for wires, consisting of a shell having converging sockets, in combination

with a pair of compressible sleeves that enter the sockets and grasp wires in the manner herein described.

508,613. UNDERGROUND ELECTRIC CONDUCTOR; J. C. Henry, Westfield, N. J. Application filed Aug. 8, 1892. A conduit for bare electric conductors consisting of pipe sections united by suitable couplings, insulating supports placed at intervals in the pipe sections and means for automatically taking up slack in the conductors.

508,615. ELECTRIC RAILWAY; J. C. Henry, Westfield, N. J. Application filed Sept. 10, 1892. In an electric railway a working conductor arranged in a zigzag or sinuous line in a horizontal plane, and a car provided with a laterally movable trolley.

508,616. ELECTRIC CAR LIGHTING SYSTEM; J. C. Henry, Westfield, N. J. Application filed April 3, 1893. In combination a motor, a clock running in opposite direction to it, an adjustable resistance and lamps controlled thereby, and gearing operated by the motor and clock increasing or diminishing the resistance when the motor falls below such predetermined speed.

508,620. FIELD MAGNET COIL AND METHOD OF MANUFACTURING SAME; J. Johnson and C. D. Haskins, Lynn, Mass. Application filed May 2, 1893. The method of constructing field magnet coils, which consists in forming a ring provided with terminals, breaking the continuity of the ring by a cut, and then inserting insulation into the cut.

508,622. ELECTRIC RAILWAY TROLLEY; W. H. Knight, New York. Application filed Aug. 10, 1888. In an electric railway a contact device for engagement with the supply conductor, having a readily detachable plug and socket connection, with bearings upon which the device moves.

508,623. STAND FOR TESTING ELECTRIC ARC LAMPS; E. R. Knowles, Middletown, Conn. Application filed Nov. 29, 1892. A stand for testing arc electric lamps, comprising a top carrying contact plates and guides for receiving and holding the base of the lamp.

508,624. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; E. R. Knowles, Middletown, Conn. Application filed March 20, 1893. This comprises a follower sliding parallel with the brush and rotatable about its axis of motion.

508,625. SWITCHBOX FOR CONTROLLING ELECTRIC CURRENTS; E. R. Knowles, Middletown, Conn., and E. H. Park, Millbury, Mass. Application filed March 31, 1893. A switch box comprising a plurality of metal bars, each having a different arrangement of notches in its edge, and a movable contact transverse to all of the bars.

508,626. STAND FOR CONTROLLING ELECTRIC CURRENTS; E. R. Knowles, Middletown, Conn. Application filed May 10, 1893. In a stand for controlling electric currents, a switch lever having at one end two spring contact pins, one of which is surrounded by an insulating bushing, and at the other end a spring contact pin and a spring plunger.

508,629. SAFETY CUT-OUT; O. Offrell, Middletown, Conn. Application filed Dec. 5, 1892. The combination of a body, line contact blocks having surface in the plane of the body edge, a cover having an unobstructed inner surface and a shoulder, plates let into the cover, arms attached to the cover and flush with the shoulder, and fuses connected with the plates and arms.

508,630. FLUID PRESSURE DEVICE FOR CONTROLLING ELECTRIC MOTORS; H. F. Parshall, Lynn, Mass., and J. W. Darley, Jr., Baltimore, Md. Application filed May 6, 1893. In a system for controlling electric motors, a source of fluid pressure, a cylinder carrying electric contacts and adapted by its rotation to vary the speed of an electric motor, and means operated by the fluid pressure and adapted to rotate the cylinder.

508,632. ELECTRIC ARC DISRUPTER; W. B. Potter, Lynn, Mass. Application filed July 13, 1893. The combination with terminals at which an arc may be formed, of a blow-out magnet provided with a closed conductor surrounding its core.

508,633. ELECTRIC RAILWAY MOTOR; E. D. Priest, Lynn, Mass. Application filed Feb. 23, 1893. An electric motor having its pole pieces loose and separate from the remainder of its field magnets.

508,634. MOUNTING ARMATURES FOR DYNAMO-ELECTRIC MACHINES; E. D. Priest, Lynn, Mass. Application filed May 15, 1893. The combination with a shaft of an inner sleeve carried thereby and having projections upon its exterior, an outer sleeve surrounding the inner sleeve and having projections upon its interior, a yielding or elastic support between the sleeves, and an armature and its commutator rigidly secured to the outer sleeve.

508,636. CONNECTOR FOR DYNAMO-ELECTRIC MACHINES; H. G. Reist and J. P. B. Fiske, Lynn, Mass. Application filed July 3, 1891. The combination with a coil having its outer layer or layers divided into sections, of connecting strips attached to the section and running to a common point on the field magnet winding, a connection block at the point to which the strips are attached, and means for connecting any two of the strips.

508,637. ARMATURE CORE; H. G. Reist, Lynn, Mass. Application filed May 24, 1893. An armature core consisting of laminae arranged side by side and separators attached to certain of the laminae to form a ventilating space or spaces in the core.

508,638. MEANS FOR REGULATING MULTIPHASE CURRENTS; E. W. Rice, Jr., Lynn, Mass. Application filed Jan. 19, 1892. The combination with a number of conductors carrying multiphase currents, of adjustable current varying devices in separate conductors, and an actuator connected to the devices to operate them simultaneously.

No. 508,489.—Device for Indicating Synchronism.

508,641. SWITCHBOARDS FOR POWER STATIONS; A. L. Rohrer, Lynn, and G. W. Mansfield, Melrose, Mass. Application filed March 5, 1891. A central power station having two or more generators connected with omnibus bars, an automatic circuit breaker in circuit between each generator and the bars, and a resetting device adjacent to all of the circuit breakers and adapted to simultaneously resent them.

508,642. SEARCH LIGHT; A. L. Rohrer, Lynn, Mass. Application filed June 20, 1882. In a search light the combination with the cell of a hollow trunnion, on which the shell is mounted and a lead wire entering same through the trunnion and terminating in a cap, with which the lamp wire has frictional contact.

508,643. CONNECTOR FOR ELECTROMAGNET COILS; M. O. Southworth, Lynn, Mass. Application filed Jan. 31, 1893. A connector for electromagnet coils, composed of a strip of metal doubled together and formed into an eye.

508,644. BRANCH BLOCK FOR INCANDESCENT LIGHTING CIRCUITS; A. Swan, Schenectady, N. Y. Application filed May 23, 1893. This consists of a branch block consisting of a base having a central projection provided with a screw thread adapted to secure a cover for the block, and with suitable line connections, these connections arranged by pairs at different heights, whereby the two sets of wires are prevented from coming in contact.

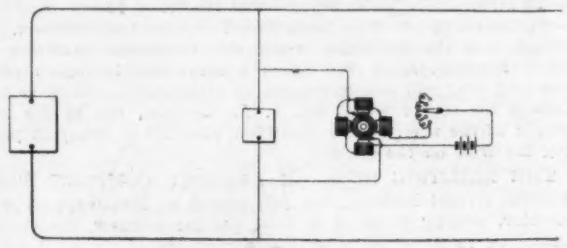
508,646. SYSTEM OF ELECTRICAL DISTRIBUTION; E. Thomson, Swampscott, Mass. Application filed Dec. 19, 1890. In a transforming generator the combination of an armature having direct and alternate current windings, with a field magnet system energized primarily by a shunt across the direct current mains, and a coil included directly in the mains which differentiates the relative strength of those parts of the field which influence the respective armature windings in keeping with the load on the work circuit.

508,647. ELECTRIC LIGHTING SYSTEM; E. Thomson, Swampscott, Mass. Application filed Aug. 12, 1891. The combination of a vertical gravitating carrier, two or more lamps mounted thereon, one above another, and detaining and releasing devices for the carrier.

508,648. LIGHTNING ARRESTER; E. Thomson, Swampscott, Mass. Application filed Aug. 26, 1891. The combination with a line circuit and a dynamo having its windings connected thereto, and its core insulated therefrom, of a connection including a spark gap between the line and core, the gap being placed in the magnetic field of the motor.

508,649. PROTECTION FOR DYNAMO-ELECTRIC MACHINES; E. Thomson, Swampscott, Mass. Application filed Aug. 26, 1891. The combination of a line, an apparatus having a portion connected to such line, and a portion insulated therefrom, inductive connections between the line and insulated portion, and a path to ground from the inductive connection and including a discharge gap.

508,650. ELECTRICAL TRANSFORMER; E. Thomson, Swampscott, Mass. Application filed Aug. 28, 1891. A transformer having a coil surrounding its coils, an inclosing case containing oil in which the coils are immersed, and insulated perforated retaining pieces for such coils.



No. 508,837.—Electrical Condenser.

508,651. CONTACT APPARATUS; E. Thomson, Swampscott, Mass. Application filed Sept. 17, 1891. A contact apparatus comprising a series of contacts connected in circuit successively to points of successively varying potential, and segmental metallic insulated supports for such contacts.

508,652. ELECTRIC CUT-OUT; E. Thomson, Swampscott, Mass. Application filed Sept. 17, 1891. An electric switch having a fixed and movable terminal, and a body of non-conducting liquid below such fixed terminal and in the path of such movable terminal.

508,653. INSULATING COMPOSITION; E. Thomson, Swampscott, Mass. Application filed Nov. 2, 1891. As a new article of manufacture, an insulating material consisting of layers of carbonaceous material alternating with layers of silicious material.

508,654. COOLING TRANSFORMER; E. Thomson, Swampscott, Mass. Application filed Feb. 4, 1892. The combination of a receptacle containing a transformer surrounded by oil, with a cooling medium circulating in a pipe passing through a greater or less portion of the fluid.

508,655. ELECTRIC TRANSFORMER; E. Thomson, Swampscott, Mass. Application filed Feb. 4, 1892. The combination of a transformer and a casing inclosing the same, with a follower between the cover of the casing and transformer and serving to maintain the latter in place.

508,656. ELECTRIC ARC LAMP; E. Thomson, Swampscott, Mass. Application filed Feb. 4, 1892. The combination with a rotary support for the carbon holder, having a depression, of a circuit controller engaging with the support and means for impelling the engaging part of the controller into the depression.

508,657. REACTIVE COIL; E. Thomson, Swampscott, Mass. Application filed Feb. 15, 1892. The combination of a regular reactive coil in each branch of a multiphase circuit, with means for varying simultaneously, and to a like amount, the reactive effects of the different coils, and a switch for cutting from circuit the coils when adjusted to give the minimum reactive effect.

508,658. DYNAMO-ELECTRIC MACHINE OR MOTOR; E. Thomson, Swampscott, Mass. Application filed May 23, 1892. An electric motor having each helix composed of a series of coils of successively finer wire, and means for switching one or more of said coils into the circuit while the motor is running.

508,659. LEADING-IN WIRE FOR INCANDESCENT LAMPS; Elihu Thomson, Swampscott, Mass. Application filed May 23, 1892. The combination with stout metallic supports fused into the stem of the lamp, of a filament attached to these supports, and leading-in wires connected with the supports.

508,660. DETECTOR FOR ELECTRIC CURRENT METERS; E. Thomson, Swampscott, Mass. Application filed Nov. 25, 1892. An electric current meter provided with an electromagnetic device controlled by the main line current and in series with the meter and adapted to respond to an attempt to shunt the meter.

508,661. ELECTRIC METER; E. Thomson, Swampscott, Mass. Application filed May 12, 1893. The combination of the field coils, the armature, and the transformer, with a non-inductive resistance of greater amount than the resistance of the armature.

508,662. INDICATING APPARATUS FOR ELECTRIC CURRENTS; E. Thomson, Swampscott, Mass. Application filed July 1, 1893. An electric measuring instrument comprising a voltmeter mechanism having a movable scale and means adapted to move the scale.

508,665. FUSE PLUG; H. C. Wirt, Boston, Mass. Application filed May 26, 1893. This consists of a base having an outer threaded shell serving as the second contact, a centre pin serving as the second contact, an insulating plate on one end of the plug, clips secured to the plate and connected with the contacts respectively, and a fuse detachably secured to the clips.

508,669. TROLLEY FOR ELECTRIC RAILWAYS; N. C. Bassett, Lynn, Mass. Application filed July 18, 1892. A trolley socket piece containing a recess in combination with a clamping plate and suitable bolts for holding the butt of the pole.

508,672. SWITCH FOR ELECTRIC RAILWAYS; E. M. Bentley, New York. Application filed Aug. 31, 1889. The combination with the main and branch conductors of a switching conductor normally spring pressed against the main conductor, a trolley pole carrying at its upper end a grooved contact device running in engagement with the under side of the conductors, and means for automatically depressing the contact below the normal plane of the main conductor at the junction, whereby the contact is enabled to pass from the main to the branch line without jar.

508,673. BRAKE APPARATUS FOR ELECTRICALLY PROPELLED CARS; F. O. Blackwell, New York. Application filed Sept. 16, 1889. The combination with an electrically propelled vehicle, a power brake and a common controlling device therefor.

508,674. RHEOSTAT; J. B. Blood, Lynn, Mass. Application filed Feb. 23, 1892. The combination of the contacts of a resistance controller for electric circuits, with a magnet having unlike poles separated by one of such contacts, and arranged adjacent to the intervals between such contact and those adjacent to it.

508,678. APPARATUS FOR TREATING FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; H. D. Burnett, Lynn, and S. E. Doane, Swampscott, Mass. Application filed Aug. 23, 1893. The combination with opposing coils of an armature comprising a beam carrying at each end two parallel discs of corrugated sheet iron.

508,680. ELECTRIC ELEVATOR; A. T. Chase, Cambridge, Mass. Application filed Dec. 16, 1891. In an electric elevator, the combination with the cab carrying a controlling device for the armature circuit, of a double pole switch controlling the line connections to the field magnet and armature and located near the elevator shaft, and a door giving access to the shaft and having an arm to positively open the switch when the door is opened, and vice versa.

508,687. CLEAT FOR ELECTRIC WIRING; F. A. Duggan, Trenton, N. J. Application filed June 28, 1893. A cleat for wiring purposes having its two parts interchangeably alike with corrugated notches on their inner faces.

508,688. ELECTRICAL TRANSFORMER; A. Ekstrom, Lynn, Mass. Application filed Nov. 16, 1892. A transformer having a plurality of primary and secondary coils, the primaries connected in series, the secondaries in multiple, the coils being alternately disposed, so that all the secondaries are exposed to equal inductive effects.

508,721. ALTERNATING CURRENT MOTOR; J. F. Cummings and C. C. Chesney, Pittsfield, Mass. Application filed Jan. 16, 1893. The combination with a source of alternating currents which differ in phase and supply, or line circuits therefrom, of two commutating motors rigidly or mechanically connected with the line circuits, so that the armature of each will be supplied with current from the same circuit as the field of the other. (See illustration.)

508,733. POWER MECHANISM FOR POINTING AND TRAINING GUNS; H. S. Maxim, London, England. Application filed Feb. 20, 1891. The combination with a gun, a fixed support, on which the same is mounted pivotally, and elevating and training gears between the support and the gun, of a motor attached to the gun by a universal joint, and means for moving the motor about its point of support and into and out of engagement with the respective gears.

508,771. CONSTRUCTION OF TROLLEY WIRES; G. Q. Seaman, Brooklyn, N. Y. Application filed July 22, 1893. In a trolley line, a wire, weighted supports connected therewith, and provided with contact and insulated faces, a feed wire, and a switch bar connecting the feed wire and trolley wire supports.

508,805. ELECTRIC BRAKE FOR RAILWAYS; A. De Bovet, Paris, France. Application filed April 23, 1892. A brake system consisting of a brake having a groove in its working face, an electro-coil arranged to magnetize the parts of the pulley separated by said groove, a flexible plate carrying iron brakeshoes entering the groove in the pulley, and a circuit for the coil.

508,807. CONVERTER SYSTEM FOR ELECTRIC RAILWAYS; C. S. Bradley, Yonkers, N. Y. Application filed May 31, 1887. In an electric railway, the combination of insulated feed conductors extending along the roadway, secondary conductors also extending along the roadway, electrical transformers having their primaries in circuit with the feeding conductors and their secondaries connected to the working conductor, and a second transformer carried by the vehicle having its primary and secondary in circuit with the working conductors and a motor on the vehicle, respectively.

508,819. MEANS FOR CUTTING ICE; L. Daft, Seattle, Wash. Application filed May 2, 1892. The combination of a frame, a series of independent conducting wires, devices for regulating the tension of each wire, and conductors between all the wires and a source of electricity.

508,827. MAGNETIC PERMEATER; E. D. Knap, Schenectady, and S. D. Strong, Greenbush, N. Y. Application filed June 28, 1893. In a magnetic permeater, a magnet having polar extensions of reduced diameter for localizing the magnetic action of the instrument.

508,829. TELEPHONE TRANSMITTER; E. Noriega, Mexico. Application filed Feb. 4, 1891. A carbon electrode for microphones, formed of charcoal, coke and a solution of boric acid.

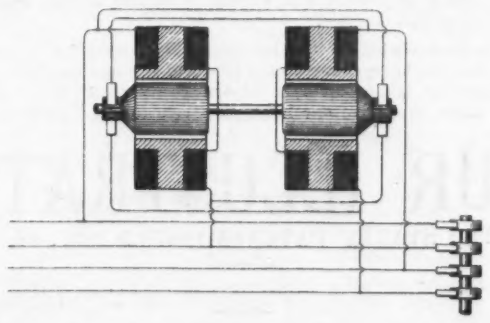
508,830. ELECTRIC TELEPHONE; E. Noriega, Mexico. Application filed Aug. 25, 1892. In a telephone transmitter, one or more carbon cylinders inclosed by iron ferrules separated from the carbon by insulating material.

508,838. ELECTRIC DISTRIBUTION; E. W. Rice, Jr., Swampscott, Mass. Application filed May 13, 1893. In a system of distribution, an alternate current transmission, a motor generator actuated by the alternating current and delivering continuous current to the circuit, and a continuous current generator in the circuit adapted to raise the electromotive force of the current.

508,839. SYSTEM OF ELECTRIC DISTRIBUTION; E. W. Rice, Jr., Swampscott, Mass. Application filed May 31, 1893. A multiphase transformer supplying separate translating devices from each coil or its secondaries.

508,851. ELECTRICAL BRAKE; E. B. Skinner, Ogden, Utah. Application filed Jan. 21, 1893. An electric brake composed of solenoids in which plungers move in response to an electric current, the plunger acting through intermediate mechanism to set the brake.

508,871. ELECTRICAL CONTACT-MAKING DEVICE; W. F. Z. Desant, New York, N. Y. Application filed Dec. 14, 1892. A contact device consisting of a rail and a contact piece on one side thereof, having its upper face on a level with the top of the rail, and a piece of insulating material between the rail and the contact piece.



No. 508,721.—Alternating Current Motor.

508,880. ELECTRIC GENERATOR; W. S. Hill, Hyde Park, Mass. Application filed April 12, 1893. A dynamo-electric machine having its armature shaft belted to a driving wheel the bearing pin of which is fixed to the main frame of the dynamo.

508,887. ELECTRICAL CONDENSER; J. F. Kelly, Pittsfield, Mass. Application filed June 10, 1893. A synchronous motor, the armature of which is adapted for connection with a circuit, and having its field excited to cause a negative lag in the current flowing in the armature. (See illustration.)

508,897. BATTERY ELEMENT; W. Mills, Elizabeth, N. J. Application filed Nov. 11, 1892. The process of making a battery element, which consists in combining granulae of stone and a carbonaceous material into a non-porous mass, granulating the mass, and reconforming the granules into a porous mass.

508,898. SYSTEM OF ELECTRICAL DISTRIBUTION; W. S. Moody, Lynn, Mass. Application filed March 17, 1893. A transformer for multiphase systems of electrical distribution, having its low potential coils wound on the "mesh" system and its high potential coils wound upon the "star" system.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1836—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.